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U. S. DEPARTMENT OF AGRICULTURE.

OFFICE OF EXPERIMENT STATIONS BULLETIN NO. 152.

A. C. TRUE, DIRECTOR.

DIETARY STUDIES WITH HARVARD UNIVERSITY STUDENTS.

BY

EDWARD MALLINCKRODT, JR.



WASHINGTON:

GOVERNMENT PRINTING OFFICE.

1905.





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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,

OFFICE OF EXPERIMENT STATIONS,

Washington, D. C., January 20, 1905.

SIR: I have the honor to transmit herewith a report of dietary studies with Harvard students carried on by Edward Mallinckrodt, jr. The desirability of such an investigation was suggested by Prof. F. G. Peabody, D. D., of Harvard University, and the work was carried out under the general direction of Prof. C. R. Sanger, a thesis based on the results being presented to the University by Mr. Mallinckrodt for the master's degree. The dietary studies were conducted in accordance with the methods devised in connection with the nutrition investigations carried on under the auspices of this Office, of which Prof. W. O. Atwater is in charge, and throughout the investigation Mr. Mallinckrodt was in consultation with Professor Atwater. Acknowledgment should be made to Dr. E. A. Darling and Dr. D. A. Sargent, of Harvard University, for cooperation in determining the physical condition and strength of the subjects. The results obtained are of especial value in their bearing upon dietary standards, particularly those of students and others of sedentary occupation, and are interesting in other ways. The report is therefore respectfully submitted with the recommendation that it be published as Bulletin No. 152 of this Office.

Respectfully,

A. C. TRUE, *Director.*

HON. JAMES WILSON,

Secretary of Agriculture.

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DIETARY STUDIES OF HARVARD STUDENTS.

INTRODUCTION.

In connection with regular university work a study was made of dietary conditions at Randall Hall, which is the smaller of the two large college commons of Harvard University and furnishes board for 1,000 students. The institution is self-supporting and managed by the student boarders with the cooperation of the college authorities, and is designed to aid students of limited means, the object being to furnish board on the European or a la carte plan at the lowest possible figure.

The results of the study above mentioned, although rendered somewhat doubtful by certain necessary assumptions, seemed to establish a strong probability that some of the students boarding at Randall Hall were living and working creditably upon a daily ration considerably below the accepted standards for men of sedentary habits. It was thought that further and more accurate dietary investigation, with observations upon the physical and mental life of these men, might bring to light some interesting and perhaps useful facts. Accordingly the investigations reported in the following pages were undertaken.

The students examined were all in moderate circumstances; many of them paid their way through college by outside work and some had to practice the strictest economy. It would have been desirable for purposes of comparison to include several men to whom economy in the matter of diet was no object; but the small compensation that it was possible to hold out to them was not sufficient to induce such men to serve as subjects. All those who agreed to serve were earnest and interested in the work, and it is largely due to their patient cooperation that the carrying out of the investigation was made possible.

GENERAL PLAN.

Ten students (designated for convenience A, B, C, etc.) who lived at Randall Hall, and whose board bills ranged from medium to very low sums, were chosen as subjects. These men were put under examination simultaneously three times during the college year for periods of three weeks each. The first period began with breakfast on November 30, 1900; the second period February 14, 1901, and the third or last period May 8, 1901. During each period of study such daily

records were kept as were necessary for computing the dietaries and each subject was required to present himself at the beginning and end of each period of observation to Dr. E. A. Darling, instructor in hygiene in Harvard University, for medical examination and to Dr. D. A. Sargent, director of the Hemenway Gymnasium at Harvard University, for strength tests. At the end of the academic year the grades attained by the men in their respective studies were obtained from the college office.

From such data the diet may be computed and the relative bodily strength, general health, and scholarship of the subjects may be estimated with tolerable accuracy. Briefly, then, an effort was made to measure four variables—diet, physical strength, general health, and mental performance. Obviously but one of these variables—the diet—is capable of measurement in physical units; the other measurements being necessarily in the nature of estimates, which are, however, approximately comparable for the different subjects.

THE SYSTEM AT RANDALL HALL.

Unlike most college commons, Randall Hall has no fixed rate for board. The cost to each student depends solely upon what he orders. Sugar, salt, and water are the only things which are served free. The building and equipment, designed especially for their present purpose, are comparatively new. During the college year covered by this investigation about 1,000 students were members of the Randall Hall Dining Association, which means that they had the privilege of boarding at Randall Hall.

Dividing the average money expenditure for one week by the number of boarders gives \$2.24 as the average weekly price of board for the whole institution, on the assumption that all members were regular boarders taking three meals a day throughout the college year of thirty-five weeks. This figure is probably too low, because the assumption that all members of the association were regular boarders is not strictly true. The average price per week paid by the men examined in the study for the three periods was \$2.66. Since the subjects were chosen from men whose board bills ranged from very low to medium amounts, it seems reasonable to conclude that the real average price paid for board at Randall Hall for the year was somewhat above \$2.66 per week.

It is worth noting that the students themselves serve as waiters. In this way many of them earn the price of their board by waiting on the table several hours each day.

For each meal each table is provided with the bill of fare for the day, showing the dishes ready to serve and the prices. In addition to these the bill of fare gives the menu of so-called "combination meals." These meals served at uniform prices (breakfast and lunch 14 cents

each and dinner 16 cents) furnish board on the "American plan" to those preferring it to the a la carte system. These combination meals supplied a varied diet, and from the data regarding them obtained as part of the study here reported it was calculated that a person living on them would obtain nearly the quantities of protein and energy called for by the commonly accepted standard for men having a small amount of muscular work.

In addition to the regular daily bills of fare each table is provided with an "extra-order list" giving a great variety of dishes that can be cooked to order. Comparatively few such dishes were used by the men studied.

The order slips made out and signed by the men are kept and serve as a basis for calculating the weekly board bills.

To obtain a list of the dishes eaten during the dietary studies each subject was required to write his order in a small notebook supplied for the purpose. A slip of carbon paper copied through the notebook leaf upon a regular "order slip" placed beneath, and this slip went to the serving room in the usual way. As a check the slips sent in by each subject were compared with his notebook at the end of each week. Before any student was accepted as a subject for this study he was given to understand that he was to eat no food outside of Randall Hall during the periods of examination. Unless this condition was absolutely agreed to the applicant was rejected. Beyond this there is no positive evidence that no food was eaten except that recorded in the notebooks, but there is on the other hand good reason to believe that the rule was strictly adhered to, since the men were of good character and showed interest in the work. Stress was laid upon the fact that there was no wish whatever to interfere with the tastes and dietary habits of the men and that all that was desired was simply a record of what they ate. They were asked to eat during the periods covered by the study just what they would at other times when no records were kept. Under these conditions the dietaries for the three periods of three weeks each at different times of the year are believed to represent the average diet of these men for the entire college year with tolerable accuracy.

It was impracticable to weigh all the "portions" or "orders" eaten by each student during three weeks, so the average weights of the various dishes were obtained by weighing, during each period of study or immediately after, a number of similar portions served on different days and averaging the figures so obtained. The number of portions weighed depended upon the importance of each article of food as a constituent of the diet studied and ranged from one to twelve for each article during each period of study. At the time of weighing samples of a considerable number of dishes were preserved for subsequent analysis by the addition of a few drops of formalin. The very great

variety and mixed character of the food, however, necessitated frequent estimations of composition, for it was impossible to sample and analyze every dish, but such estimates were confined to unimportant foods—that is, to those not often used and to such as supplied little nutritive material.

The following table shows the cost, average weight, and amounts of protein and energy in one “portion” or “order” of the various dishes used. The table also shows which of the foods were analyzed and which had their nutritive value computed from average figures. The data recorded served as a basis for computing the individual dietaries.

TABLE 1.—*Percentage of protein, amount of energy per gram, and average weight, cost, amount of protein, and energy per order of different kinds of food.*

Reference number.	Kind of food.	Proportion of protein.	Energy per gram.	Period in which used.	Number of orders weighed.	Average per order.			
						Weight.	Cost.	Protein.	Energy.
		<i>Per ct.</i>	<i>Cal.</i>	<i>No.</i>		<i>Grams.</i>	<i>Cents.</i>	<i>Grams.</i>	<i>Cal.</i>
1	Beef:								
2	Boiled <i>c</i>	28.0	2.63	.....	.....	135	10	38	355
3	Braised <i>c</i>	28.0	2.63	.....	.....	327	10	92	860
4	Corned <i>b</i>	26.3	3.26	2	2	105	8	28	342
5	Do. <i>b</i>	26.3	3.26	3	2	108	8	28	352
6	Average.....	26.3	3.26	....	4	106	8	28	346
7	Roast <i>a</i>	24.1	3.16	1	5	82	10	20	259
8	Do. <i>b</i>	24.1	3.16	2	2	92	10	22	291
9	Do. <i>b</i>	24.1	3.16	3	7	86	10	21	272
10	Stew <i>a</i>	23.7	2.10	1	2	327	10	78	687
11	Steak <i>a</i>	30.9	2.97	1	3	98	10	30	291
12	Do. <i>b</i>	30.9	2.97	2	5	115	10	36	342
13	Do. <i>b</i>	30.9	2.97	3	5	109	10	34	324
14	Hamburg steak <i>b</i>	28.0	2.63	2	1	133	10	37	350
15	Rump steak <i>b</i>	23.5	3.27	2	1	175	20	41	572
16	Tenderloin <i>b</i>	23.5	3.27	2	1	208	50	49	680
17	Tongue <i>c</i>	12.8	2.67	.....	.....	108	10	14	288
18	Tripe <i>c</i>	11.7	.78	.....	.....	125	10	15	98
19	Croquettes <i>b</i>	28.0	2.63	1	1	279	10	78	734
20	Do. <i>b</i>	28.0	2.63	2	1	234	10	66	615
21	Hash <i>b</i>	12.0	1.78	1	2	171	7	21	304
22	Do. <i>b</i>	12.0	1.78	2	2	170	7	20	303
23	Do. <i>b</i>	12.0	1.73	3	2	265	6	32	472
23a	Frizzled beef with eggs <i>b</i>	10.7	1.54	1	1	177	10	19	273
24	Do. <i>a</i>	10.7	1.54	2	1	154	10	17	237
24a	Do. <i>b</i>	10.7	1.54	3	1	112	9	12	172
25	Average.....	10.7	1.54	....	3	148	10	16	227
26	Potpie <i>a</i>	17.3	3.13	1	2	265	10	46	829
27	Do. <i>b</i>	17.3	3.13	2	2	220	10	38	689
28	Venl:								
29	Cutlets <i>b</i>	31.0	2.39	2	1	136	15	42	325
30	Roast, <i>b</i> with gravy and dressing <i>u</i> (see reference No. 29).....	31.0	2.39	2	1	127	10	39	304
31	Gravy and dressing with roast <i>b</i> (see No. 28).....	1.9	.78	2	1	86	10	2	67
32	Venison potpie <i>c</i>	17.3	3.13	.....	.....	265	10	46	829
33	Mutton and lamb:								
34	Chops <i>b</i>	21.7	4.07	2	1	73	4 25	16	297
35	Roast <i>b</i>	19.7	2.32	1	1	75	10	15	174
36	Do. <i>b</i>	19.7	2.32	2	2	124	10	21	288
37	Do. <i>b</i>	19.7	2.32	3	1	120	10	21	278
38	Roast, cold <i>b</i>	19.7	2.32	2	1	106	10	21	246
39	Tongue <i>b</i>	12.8	2.67	2	1	108	10	14	288
40	Croquettes <i>c</i>	21.7	4.07	1	.....	257	10	56	1,046
41	Mixed <i>c</i> (with toast) (see No. 110) ..	19.7	2.32	.....	.....	135	8	27	313

TABLE 1.—Percentage of protein, amount of energy per gram, and average weight, cost, amount of protein, and energy per order of different kinds of food—Continued.

Reference number.	Kind of food.	Proportion of protein.	Energy per gram.	Period in which used. Number of orders weighed.		Average per order.			
						Weight.	Cost.	Protein.	Energy.
		<i>Per ct.</i>	<i>Cal.</i>	<i>No.</i>		<i>Grams.</i>	<i>Cents.</i>	<i>Grams.</i>	<i>Cal.</i>
Pork:									
39	Bacon <i>b</i> with eggs ^r (see No. 78)	22.7	7.31	1	1	31	4	7	227
40	Do. <i>b</i>	22.7	7.31	2	1	43	4	10	314
41	Do. <i>b</i>	22.7	7.31	3	1	26	4	6	190
42	Chops <i>c</i>	21.1	6.62	.....	.....	190	10	40	1,258
43	Cutlets <i>b</i> with fried apples ^u (see No. 242)	21.1	6.62	2	1	194	15	41	1,284
44	Ham, cakes <i>c</i>	22.2	4.41	.....	.....	195	10	43	860
45	Ham, fried <i>b</i>	22.2	4.41	2	2	80	10	18	353
46	Do. <i>b</i>	22.2	4.41	3	1	68	10	15	300
47	Ham hashed with eggs <i>b</i>	22.5	3.27	3	1	195	10	44	638
48	Ham fried <i>c</i> (with eggs <i>r</i>) (see No. 78) ..	22.2	4.41	.....	.....	80	12	18	353
49	Ham boiled <i>c</i> (with eggs <i>r</i>) (see No. 78) ..	20.2	3.28	1	.....	76	10	15	249
50	Sausage <i>b</i>	19.8	6.27	2	2	116	8	23	727
Poultry:									
51	Chicken pie <i>b</i>	21.8	2.43	1	1	233	12	51	566
52	Chicken wings <i>b</i> with toast ^u (see No. 139)	17.6	2.18	2	1	94	10	17	205
53	Chicken wings <i>b</i> with toast ^u	17.6	2.18	3	1	85	10	15	185
54	Turkey, roast, with dressing <i>a</i>	20.2	1.86	1	1	245	15	49	456
55	Do. <i>b</i>	20.2	1.86	2	2	287	15	58	534
56	Do. <i>b</i>	20.2	1.86	3	2	298	15	60	554
Soups:									
57	Chowder <i>a</i>	2.5	.53	2	4	246	3	6	130
58	Puree of peas <i>a</i>	4.0	.95	2	3	189	3	8	180
59	Soups <i>a</i>	2.8	.44	1	8	193	3	5	85
60	Do. <i>a</i>	1.8	.26	2	8	213	3	4	55
61	Do. <i>d</i>	2.9	.45	3	.....	203	3	6	91
Fish:									
62	Bass and cod, fried <i>c</i>	25.9	1.89	.....	.....	140	10	36	265
63	Halibut, fried <i>b</i>	32.6	4.08	2	2	140	10	46	571
64	Mackerel, broiled <i>b</i>	21.8	1.80	3	4	145	10	32	261
65	Smelts, fried <i>b</i>	25.9	1.89	1	1	121	10	31	229
66	Sea trout, fried trout, baked whitefish <i>b</i>	25.9	1.89	3	1	122	10	32	231
67	Lobsters, boiled <i>b</i>	18.1	1.15	2	1	98	25	18	113
68	Oysters, raw, 1 dozen <i>c</i>	6.0	.59	.....	.....	200	15	12	118
69	Oysters, fried <i>c</i>	6.0	.59	.....	.....	114	25	7	67
70	Oyster stew, ordinary <i>a</i>	4.1	.54	1	1	197	10	8	106
71	Do. <i>b</i>	4.1	.54	2	1	257	10	11	139
72	Oyster stew, special <i>a</i>	3.8	.57	2	2	420	15	16	239
73	Oyster pie <i>c</i>	17.3	3.13	.....	.....	220	12	38	689
74	Scallops, fried <i>b</i>	25.4	1.54	1	1	106	10	27	163
75	Shrimp salad with dressing <i>b</i>	25.4	1.54	3	1	183	15	46	282
76	Fish balls <i>b</i>	12.9	2.11	1	2	158	5	20	333
76a	Do. <i>b</i>	12.9	2.11	2	1	149	5	19	314
Eggs, hens':									
77	2 raw, boiled, and dropped <i>c</i>	13.1	1.64	.....	.....	101	8	13	166
78	2 fried, <i>b</i> ^{<i>l</i>}	13.0	2.45	1	1	94	8	12	230
79	Do. <i>c</i>	13.0	2.45	2	.....	87	8	11	213
80	Do. <i>a</i>	13.0	2.45	3	3	85	6	11	208
81	Omelet <i>b</i>	12.3	2.42	1	1	158	10	19	382
82	Do. <i>b</i>	12.3	2.42	2	3	188	10	23	455
83	Do. <i>a</i>	12.3	2.42	3	6	158	8	19	382
84	Scrambled <i>b</i>	24.1	5.20	1	1	168	10	40	874
85	Do. <i>b</i>	24.1	5.20	2	3	147	10	35	764
86	Do. <i>a</i>	24.1	5.20	3	6	176	8	42	915
Dairy products:									
87	Butter <i>b</i>	1.0	7.92	1	11	12	1	.....	95
88	Do. <i>b</i>	1.0	7.92	2	3	12	1	.....	95
89	Do. <i>b</i>	1.0	7.92	3	7	13	1	.....	103
90	Cheese <i>b</i>	25.9	4.68	2	1	20	1	5	94
91	Cheese, sage <i>b</i>	25.9	4.68	1	1	17	1	4	80
92	Cream <i>b</i>	2.5	2.03	3	3	65	2	2	132
93	Cream <i>b</i> with strawberries (see No. 256)	2.5	2.03	3	7	45	10	1	91
94	Milk, bowl <i>b</i>	3.5	.76	3	3	346	4	12	263
95	Milk, glass <i>a</i>	3.5	.76	1	12	188	2	7	143
96	Milk, pitcher <i>b</i>	3.5	.76	1	9	101	1	4	77
Breakfast cereals, etc.:									
97	Prepared cereal <i>b</i>	11.7	4.15	1	3	68	4	8	282
98	Do. <i>b</i>	11.7	4.15	2	4	56	4	7	232
99	Do. <i>b</i>	11.7	4.15	3	3	68	4	8	282

TABLE 1.—Percentage of protein, amount of energy per gram, and average weight, cost, amount of protein, and energy per order of different kinds of food—Continued.

Reference number	Kind of food.	Proportion of protein.	Energy per gram.	Period in which used.	Number of orders weighed.	Average per order.			
						Weight.	Cost.	Protein.	Energy.
		Per ct.	Cal.	No.		Grams.	Cents.	Grams.	Cal.
Breakfast cereals, etc.—Continued.									
100	Hominy, boiled <i>a</i>	1.8	0.85	1	4	203	4	4	173
101	Do. <i>b</i>	1.8	.85	2	4	199	3	4	169
102	Do. <i>b</i>	1.8	.85	3	5	191	3	3	162
103	Oatmeal, boiled <i>a</i>	3.7	1.03	1	5	206	4	8	212
104	Do. <i>a</i>	2.3	.65	2	4	220	3	5	143
105	Do. <i>b</i>	3.0	.84	3	4	226	3	7	190
106	Rice, boiled <i>a</i>	2.5	1.17	1	3	148	4	4	173
107	Do. <i>b</i>	2.5	1.17	2	3	129	3	3	151
108	Do. <i>b</i>	2.5	1.17	3	5	142	3	4	166
109	Shredded wheat biscuits, 2 <i>c</i>	10.5	4.01	.....	.....	56	4	6	225
110	Wheat, boiled <i>a</i>	2.0	.73	2	5	229	3	5	167
111	Do. <i>b</i>	2.0	.73	3	2	233	3	5	170
112	Average.....	2.0	.73	.....	7	231	43	5	169
Bread, crackers, etc.:									
113	Bread, white <i>b</i>	9.2	2.88	1	9	64	1	6	184
114	Do. <i>b</i>	9.2	2.88	2	10	64	1	6	184
115	Do. <i>b</i>	9.2	2.88	3	10	68	1	6	196
116	Bread, Graham <i>b</i>	8.9	2.87	1	8	68	1	6	195
117	Do. <i>b</i>	8.9	2.87	2	10	70	1	6	201
118	Do. <i>b</i>	8.9	2.87	3	11	66	1	6	189
119	Bread, corn <i>b</i>	7.9	2.84	1	6	43	1	3	122
120	Do. <i>b</i>	7.9	2.84	2	10	50	1	4	142
121	Do. <i>b</i>	7.9	2.84	3	10	44	1	3	125
122	Bread, Boston brown <i>b</i>	5.4	2.46	1	1	191	2	10	470
123	Do. <i>b</i>	5.4	2.46	2	2	181	2	10	445
124	Do. <i>b</i>	5.4	2.46	3	1	141	2	8	347
125	Biscuit, soda <i>b</i>	9.3	4.02	1	4	58	1	5	233
126	Do. <i>b</i>	9.3	4.02	2	4	49	1	5	197
127	Do. <i>b</i>	9.3	4.02	3	6	51	1	5	205
128	Gems, Graham <i>b</i>	8.9	2.87	2	8	37	1	3	106
129	Do. <i>b</i>	8.9	2.87	3	6	38	1	3	109
130	Average.....	8.9	2.87	.....	14	38	1	3	109
131	Rolls <i>b</i>	9.0	3.08	1	15	49	1	4	151
132	Do. <i>b</i>	9.0	3.08	2	18	48	1	4	148
133	Do. <i>b</i>	9.0	3.08	3	17	55	1	5	169
134	Toast, dry <i>c</i>	11.5	3.39	.....	.....	55	2	6	186
135	Toast, buttered <i>a</i>	9.0	4.11	2	5	74	3	7	304
136	Do. <i>b</i>	9.0	4.11	3	5	66	3	6	271
137	Average.....	9.0	4.11	.....	10	70	3	6	288
138	Toast, creamed <i>c</i>	9.2	2.88	.....	.....	70	<i>m</i> 7	6	202
139	Toast <i>b</i> , with chicken wings (see No. 52)	11.5	3.39	2	1	46	<i>r</i> 0	5	156
140	Toast <i>c</i> , with eggs and with minced lamb (see Nos. 77 and 38).....	11.5	3.39	.....	.....	27	2	3	91
141	Toast <i>b</i> , with asparagus (see No. 218)...	11.5	3.39	3	2	25	<i>r</i> 0	3	85
142	Scones <i>b</i>	9.3	4.02	2	3	40	1	4	161
143	Buckwheat cakes <i>b</i>	7.1	2.09	1	1	135	5	10	282
144	Do. <i>b</i>	7.1	2.09	2	1	156	5	11	326
145	Griddlecakes <i>b</i>	7.1	2.09	2	3	161	5	11	336
146	Do. <i>a</i>	7.1	2.09	3	5	192	4	14	401
147	Average.....	7.1	2.09	.....	8	177	5	13	370
148	Crackers, Graham <i>b</i>	10.0	4.55	1	1	52	3	5	237
149	Do. <i>b</i>	10.0	4.55	2	1	55	3	6	250
150	Oyster crackers <i>b</i>	11.3	4.59	1	1	46	2	5	211
151	Do. <i>b</i>	11.3	4.59	2	3	51	2	6	234
152	Crackers for soup <i>b</i>	11.3	4.59	1	7	46	1	5	211
153	Do. <i>b</i>	11.3	4.59	2	4	44	1	5	202
154	Average.....	11.3	4.59	.....	11	45	1	5	207
155	Macaroni <i>a</i>	3.9	1.16	1	3	199	7	8	231
156	Do. <i>b</i>	3.9	1.16	3	3	226	6	9	262
157	Average.....	3.9	1.16	.....	6	213	7	8	247

TABLE 1.—Percentage of protein, amount of energy per gram, and average weight, cost, amount of protein, and energy per order of different kinds of food—Continued.

Reference number.	Kind of food.	Proportion of protein.	Energy per gram.	Period in which used.	Number of orders weighed.	Average per order.			
						Weight.	Cost.	Protein.	Energy.
		Per ct.	Cal.	No.		Grams.	Cents.	Grams.	Cal.
158	Desserts, etc.:								
159	Cake, <i>b</i> average of several kinds <i>h</i>	6.3	3.89	1	5	47	1	3	183
160	Do. <i>b</i>	6.3	3.89	2	9	44	1	3	171
161	Do. <i>b</i>	6.3	3.89	3	3	50	1	3	194
162	Cookies <i>b</i>	7.0	4.35	1	2	32	1	2	139
163	Do. <i>b</i>	7.0	4.35	2	6	33	1	2	144
164	Do. <i>b</i>	7.0	4.35	3	2	38	1	3	165
165	Doughnuts <i>b</i>	6.7	4.61	1	3	47	1	3	217
166	Do. <i>b</i>	6.7	4.61	2	2	38	1	3	175
167	Do. <i>b</i>	6.7	4.61	3	1	49	1	3	226
168	Eclairs <i>b</i>	4.1	1.87	2	2	146	4	6	273
169	Gingerbread <i>b</i>	5.8	3.84	1	6	43	1	2	165
170	Do. <i>b</i>	5.8	3.84	2	6	46	1	3	177
171	Do. <i>b</i>	5.8	3.84	3	3	49	1	3	188
172	Fritters, apple <i>c</i>	3.1	2.86	2	5	158	7	5	452
173	Pies, <i>b</i> average of several kinds <i>h</i>	4.1	2.94	1	2	172	5	7	506
174	Do. <i>b</i>	4.1	2.94	2	5	158	5	6	465
175	Do. <i>b</i>	4.1	2.94	3	8	150	4	6	441
176	Puddings, <i>a</i> average of several kinds <i>h</i>	4.1	1.87	1	13	183	5	8	342
177	Do. <i>b</i>	4.1	1.57	2	11	187	4	8	294
178	Do. <i>b</i>	4.1	1.72	3	1	172	4	7	296
179	Pudding, Indian <i>b</i>	5.5	1.90	3	1	150	4	8	285
180	Strawberry shortcake <i>b</i> , berries <i>u</i> (see No. 180).	1.0	.40	3	2	82	7	1	33
181	Strawberry shortcake, <i>b</i> crust (see No. 179).	6.3	3.89	3	2	126	10	8	490
182	Tarts, damson, raspberries, etc. <i>b</i>	4.1	2.94	2	3	78	2	3	229
183	Ice cream <i>b</i>	2.7	2.09	1	1	120	7	3	251
184	Do. <i>b</i>	2.7	2.09	2	2	138	7	4	288
185	Do. <i>b</i>	2.7	2.09	3	4	114	7	3	238
186	Jelly, coffee <i>a</i>	2.8	1.01	1	3	127	4	4	128
187	Do. <i>b</i>	2.8	1.01	2	5	115	4	3	116
188	Do. <i>b</i>	2.8	1.01	3	4	119	4	3	120
189	Sherbet <i>c</i>	1.28		1	....	76	6	.....	97
190	Vegetables:								
191	Beans, baked <i>a</i>	8.2	1.53	1	5	209	4	17	320
192	Do. <i>b</i>	8.2	1.53	2	4	226	4	19	346
193	Do. <i>b</i>	8.2	1.53	3	4	198	4	16	303
194	Beans, Lima <i>b</i>	7.2	1.15	1	2	88	3	6	101
195	Do. <i>a</i>	7.2	1.15	2	2	95	3	7	109
196	Do. <i>b</i>	7.2	1.15	3	2	90	2	6	104
197	Beans, wax <i>b</i>	1.0	.20	3	2	64	2	1	13
198	Average.....	3.6	.64	....	6	83	3	3	53
199	Potatoes, baked <i>b</i>	2.6	1.05	1	4	141	2	4	148
200	Do. <i>b</i>	2.6	1.05	2	12	149	2	4	156
201	Do. <i>b</i>	2.6	1.05	3	7	129	2	3	135
202	Potatoes, boiled <i>b</i>	2.5	1.01	3	4	143	2	4	144
203	Potatoes, mashed <i>b</i>	2.6	1.16	1	5	136	2	4	158
204	Do. <i>b</i>	2.6	1.16	2	6	141	2	4	164
205	Do. <i>b</i>	2.6	1.16	3	6	143	2	4	166
206	Potatoes, stewed <i>c</i>	2.5	1.01	....	....	143	2	4	144
207	Potatoes, fried <i>d</i>	3.4	2.55	1	....	125	2	4	319
207a	Do. <i>a</i>	3.4	1.94	2	5	119	2	4	231
208	Do. <i>b</i>	3.4	2.25	3	3	130	2	4	292
209	Potatoes, French fried <i>b</i>	3.4	2.25	3	3	85	5	3	191
210	Potatoes, German fried, and griddled <i>c</i>	3.4	2.25	....	....	130	f 2	4	292
211	Potatoes, lyonnaise <i>b</i>	3.4	2.25	1	2	88	s 2	3	198
212	Do. <i>b</i>	3.4	2.25	3	4	112	2	4	252
213	Average.....	3.4	2.25	....	6	100	2	3	225
214	Potatoes, hashed, brown <i>b</i>	3.4	2.25	3	1	179	2	6	403
215	Potato salad <i>b</i>	2.5	1.01	2	1	117	5	3	118
216	Sweet potatoes, boiled and baked <i>b</i>	3.0	2.11	1	3	185	2	6	390
217	Do. <i>b</i>	3.0	2.11	2	5	183	2	5	386
218	Asparagus, <i>b</i> with toast <i>u</i> (see No. 141)...	1.5	.20	3	2	60	8	1	12
219	Beets, pickled <i>b</i>	2.3	.44	3	1	83	3	2	37
220	Cabbage <i>b</i>	1.6	.34	2	1	108	3	2	37
221	Do. <i>b</i>	1.6	.34	3	1	147	2	2	50

TABLE 1.—Percentage of protein, amount of energy per gram, and average weight, cost, amount of protein, and energy per order of different kinds of food—Continued.

Reference number	Kind of food.	Proportion of protein.	Energy per gram.	Period in which used.	Number of orders weighed.	Average per order.			
						Weight.	Cost.	Protein.	Energy.
		<i>Per ct.</i>	<i>Cal.</i>	<i>No.</i>		<i>Grams.</i>	<i>Cents.</i>	<i>Grams.</i>	<i>Cal.</i>
Vegetables—Continued.									
222	Celery <i>c</i>	1.1	0.20	.....	.....	75	5	1	15
223	Corn, stewed <i>b</i>	2.8	1.05	1	4	78	3	2	82
224	Do. <i>b</i>	2.8	1.05	2	1	63	3	2	66
225	Do. <i>b</i>	2.8	1.05	3	4	83	2	2	87
226	Onions, raw <i>b</i>	1.6	.52	3	1	81	3	1	42
227	Onions, boiled <i>b</i>	1.2	.43	3	2	91	3	1	39
228	Radishes <i>b</i>	1.3	.32	3	2	66	4	1	21
229	Spinach <i>c</i>	2.1	.60	.....	.....	125	2	3	75
230	Succotash <i>b</i>	3.6	1.05	1	2	90	3	3	95
234	Do. <i>b</i>	3.6	1.05	3	3	91	2	3	96
232	Tomatoes, stewed <i>b</i>	1.2	.25	2	3	107	3	1	27
233	Do. <i>b</i>	1.2	.25	3	4	89	2	1	22
234	Average.....	1.2	.25	.....	7	98	3	1	24
235	Turnips <i>b</i>	1.3	.60	3	1	168	02	2	101
236	Hash, vegetable <i>c</i>	3.4	2.25	.....	.....	179	6	6	403
237	Pickles, sweet <i>c</i>	1.1	.25	.....	.....	67	5	1	17
238	Pickles <i>b</i>	1.1	.25	2	1	67	1	1	17
239	Do. <i>b</i>	1.1	.25	3	2	58	1	1	15
Fruits:									
240	Apples <i>b</i>	.3	.48	2	6	127	2	.4	61
241	Apples, baked <i>c</i>	.6	.77	.....	.....	157	4	1	121
242	Apples, <i>b</i> fried, with pork cutlets (see No. 43).....	.2	1.57	2	1	63	10	.....	99
243	Bananas <i>b</i>	.8	.65	2	6	155	2	1	101
244	Do. <i>b</i>	.8	.65	3	6	140	2	1	91
245	Average.....	.8	.65	.....	12	148	2	1	96
246	Cherries, canned <i>b</i>	1.1	.91	2	1	85	4	1	77
247	Grapes <i>b</i>	1.0	.74	1	1	105	3	1	78
248	Do. <i>b</i>	1.0	.74	2	1	185	5	2	137
249	Figs, dried <i>b</i>	1.3	3.22	2	1	87	4	4	280
250	Oranges <i>b</i>	.6	.38	2	6	228	3	1.4	87
251	Do. <i>b</i>	.6	.38	3	6	234	3	1.4	89
252	Average.....	.6	.38	.....	12	231	3	1.4	88
253	Peaches, canned <i>b</i>	.7	.48	2	1	69	4	.....	33
254	Prunes, stewed <i>b</i>	.6	1.16	1	2	112	4	1	130
255	Do. <i>b</i>	.6	1.16	3	2	94	4	1	109
256	Strawberries <i>b</i> with cream <i>c</i> (see No. 93).....	1.0	.40	3	7	135	07	1	54
257	Preserves, <i>a</i> average of several kinds <i>b</i>	.5	2.45	2	4	66	4	.....	162
258	Sauces, <i>b</i> average of several kinds <i>b</i>	.7	.81	3	3	98	4	1	79
Sugars, etc.:									
259	Sugar, teaspoonfuls <i>c</i>.....	.....	3.95	.....	.....	9	10	.....	36
260	Sirup <i>c</i>.....	.....	2.77	.....	.....	75	2	.....	208
261	Honey <i>c</i>.....	.....	3.21	.....	.....	75	4	.....	241
Beverages: <i>p</i>									
262	Cocoa <i>d</i>	1.1	.31	.....	.....	184	3	2	57
263	Coffee <i>d</i> and tea <i>d</i>	.8	.17	.....	.....	184	3	1	31
264	Cereal coffee <i>c</i>	.2	.07	.....	.....	184	3	.....	13
265	Chocolate <i>d</i>	2.1	.72	.....	.....	184	5	4	132
266	Birch beer, ginger ale, sarsaparilla <i>c</i>.....	.....	.45	.....	.....	225	5	.....	101
267	Lemonade <i>c</i>.....	.....	.45	.....	.....	200	2	.....	90
Combination meals: <i>i</i>									
268	Breakfasts.....	4.6	1.25	1	.....	570	10	26	710
269	Do.	4.2	1.34	2	.....	591	10	25	790
270	Do.	4.4	1.34	3	.....	545	10	24	728
271	Lunches.....	4.9	1.70	1	.....	534	10	26	908
272	Do.	6.4	1.99	2	.....	499	10	32	993
273	Do.	4.0	1.58	3	.....	428	10	17	675
274	Dinner.....	6.1	1.46	1	.....	527	12	32	769
275	Do.	5.7	1.33	2	.....	534	12	30	704
276	Do.	5.2	1.39	3	.....	456	12	24	638

a Percentage of protein, energy per gram, and average weight per order actually determined.*b* Percentage of protein and energy per gram, estimated, either from analyses of similar materials previously published (U. S. Dept. Agr., Office of Experiment Stations Buls. 28 and 75), or from

determinations made in connection with these studies, on materials sampled in one period but used in another. Average weight per order actually found.

^c Percentage of protein, energy per gram, and average weight per order, all estimated from corresponding data for similar materials.

^d Percentage of protein and energy per gram actually determined, but average weight per order estimated from that of similar materials.

^e The cost per order decreased 2 cents in period 3.

^f "German fried" potatoes cost 2 cents, but "griddled" cost 10 cents per order.

^g In periods 1 and 2 the cost per order was 3 cents.

^h The average weight per order of pie was ascertained from the weighings of a number of orders of different kinds of pie. When the subject used several kinds during the same period, this average weight was used in computing the amount of protein and energy obtained; but when only one kind was used, the weight per order of that particular kind was taken for the computation. The same is true of preserves, puddings, sauces, and cake. The cost per order of cake is here given as 1 cent, since that was the price in the majority of cases. For some kinds, however, the cost was larger; consequently the total cost for cake given in the tables of some of the studies is not equal to the number of orders times the price here given. These differences are noted in the tables beyond.

ⁱ In the case of the combination meals, as here tabulated, the figures for percentage of protein, energy per gram, cost, and weight per order do not include the corresponding data for the bread and the tea, coffee, or milk that always formed part of such meals. Since the quantity of both the bread and the drink with the meal was the same as in the usual "orders" of these materials they may be recorded with separate orders of the same materials, and in computing the results of the studies it was found more convenient to record them thus. Accordingly, the price of the combination meals as actually served is here reduced by the price of the bread and the drink deducted. The proportion of protein and energy per gram of the combination meals, minus the bread and drink, were ascertained from the amount, protein content, and energy value of the various materials that were included. For the most part these data were obtained by actual determinations on samples of the materials, though in the case of a few of the less important materials the data were estimated.

^j Hot milk cost 5 cents per bowl.

^k The cost per order was 4 cents in period 1.

^l Sometimes formed part of an order, with bacon or ham. See note *u*.

^m The cost per order decreased 1 cent in period 3.

ⁿ The weight per order of sea trout was 120 grams.

^o The cost per order of strawberries varied from week to week during the same period. The total cost for this item in any study is that of the total number of orders at the price actually paid rather than at the average price here given.

^p Tea and coffee that contained neither milk nor sugar were assumed to contain no nutrients.

^q A special order.

^r In the case of sugar there was no charge. In the case of other materials thus marked the cost was included elsewhere, as shown by the cross references.

^s The regular price of lyonnaise potatoes was 2 cents per order, but in a few cases some special orders that cost 5 cents each were served.

^t Fried bass cost 10 cents, fried cod 11 cents, per order.

^u and ^v Some orders included more than one kind of food material, each of different composition; for example, ham and eggs (No. 48) or veal with gravy and dressing (No. 28). To calculate the quantity of protein and energy in the whole order it was necessary to ascertain the weight, percentage of protein, and energy per gram for each kind of material. In the case of such orders as veal and dressing, where the one was always accompanied by the other, the cost per order is given with the main item, and the other is marked 0. In the case of such orders as ham and eggs, where either part could be ordered separately, the cost of each part is given by itself.

Where average figures are given in the table above, the average figures in the last two columns are obtained by multiplying the average weight per order by the average percentage of protein and energy per gram rather than by summing the individual items and dividing by the number of items.

With the foregoing data regarding the weight, cost, and amounts of protein and energy for one average order of each of the various dishes at our disposal, and having in addition a record of the number of times each dish was eaten by the man in question, the calculation of the daily ration becomes possible. In making such calculations, however, it is very essential that the information given in the footnotes to the table above be also taken into consideration. The tables following the explanatory data given in the account of each dietary study beyond show the cost and the amounts of protein and energy in the average food eaten daily during the periods included. The numbers in parentheses after the names of the foods refer to the places where those articles may be found in Table 1 above. The second number indicates the number of orders eaten and the third shows the total cost of the orders. For example, in Table 3 we find the item "chowder (57), 2, 6 cents," which means that the composition, cost, etc., of an order of chowder may be found by looking up No. 57 in Table 1, that two orders were eaten, and that the total cost was 6 cents.

In the tables showing the results of the studies all food materials are grouped under 13 general classes, viz, soups, dairy products, cereals, breads, desserts, vegetables, fruits, beverages, combination meals, sugars (ordinary sugar and sirup), meats (including hash, unless otherwise itemized), fish, and eggs. Combination meals appear without bread and beverages and represent the characteristic part of the meal only. It is the custom at Randall Hall to serve with the combination meals several kinds of bread, and tea, coffee, or milk at the option of the individual. Since the size of the portions of bread and the quantity of the beverages are the same as when ordered separately, these may be recorded as if separate from the combination meals and, both for the sake of convenience and in order that the different kinds of food materials might, so far as possible, be grouped according to their respective classes, this method was followed in the tables. The actual value of a combination meal as served is greater than would appear from the figures in the tables by the nutrients contained in that particular selection of bread and drink which accompanied the meal; the cost likewise is greater by 2 cents. On the other hand, the figures indicating the nutrients and energy furnished by separate orders of breads and beverages are necessarily too high by the same amount that the combination meals appear too low, and the same applies to the cost. However, it is plain that the matter is simply one of distribution, the final value of the ration being, of course, unaffected.

The data showing the nutritive value of the diet are calculated on the basis of digestible protein and available energy in addition to the more usual basis which refers to amounts eaten. The figures for digestible protein and available energy were included and used in the discussion because it was believed that these data could be calculated with reasonable accuracy by means of factors, and that the results so obtained offered a more satisfactory basis for comparison and discussion than the statistics of quantities eaten.

The factors or coefficients employed for digestibility of protein and availability of energy were deduced from the results of a large number of studies carried on in connection with the nutrition investigations of the Office of Experiment Stations and other similar work, and are given in Table 2 below. Their accuracy, the importance of many of them, the relation between digestible or available nutrients and nutrients eaten, and related topics have been discussed in detail by Atwater^a and by Atwater and Bryant,^b and also referred to in earlier bulletins of this series.^c

The figures show how much of the protein of different foods and food groups is digested—that is, taken up by the body and utilized.

^aConnecticut Storrs Station Rpt. 1899, p. 69.

^bIbid., p. 73.

^cU. S. Dept. Agr., Office of Experiment Stations Buls. 126, p. 19, and 136, p. 105.

In a similar way the figures for energy show how much of the total energy of the food has been made available for the uses of the body in the processes of digestion and assimilation.

TABLE 2.—*Coefficients of digestibility of protein and availability of energy of different classes of food materials.*

Class of food.	Protein.	Energy.
	<i>Per cent.</i>	<i>Per cent.</i>
Soups	97	86
Meats	97	87
Fish	97	85
Eggs	97	89
Dairy products	97	93
Breakfast cereals	85	91
Bread, crackers, etc.	85	91
Desserts	85	93
Vegetables	83	91
Fruits	85	88
Sugars	..	98
Beverages	97	98
Combination meals	92	92

DETAILS OF THE DIETARIES.

In the following pages the details of the dietary studies with the ten students are recorded.

DIETARY STUDY NO. 401.

The subject of dietary study No. 401, who is designated A, was 31 years of age^a, 5 feet 1.8 inches in height, and weighed 106.7 pounds. In physical development and state of nutrition he was decidedly below the average, as was also the case with his bodily strength. He was a student in the graduate school, his course being exclusively mathematical and rather difficult. He slept 7 or 8 hours, and devoted one-half hour to gymnasium exercise or walked 30 minutes to 2 hours daily. The main part of his day was spent at intellectual work, averaging 8 to 10 hours. There was practically no change in the programme throughout the year.

The following table shows the results for the three periods of the dietary study and the average results for the whole investigation.

^aThis and all similar data refer to values at the beginning of the experimental period.

TABLE 3.—*Kinds of food, number of orders, and cost of each kind, and average cost and amounts of protein and energy of dietary study No. 401.*

SUBJECT A.

[For explanation of numbers in parentheses, see p. 11.]

Kinds of food, number of orders, and cost of each kind.	Cost, protein, and energy of daily food.				
	Total.			Digestible protein.	Available energy.
	Cost.	Protein.	Energy.		
<i>Period 1, 3 weeks, November 30 to December 20.</i>					
Chowder (57), 2, 6 cents; soup (59), 13, 39 cents. Total soups, etc.....	<i>Cents.</i> 2.1	<i>Grams.</i> 3.9	<i>Calories.</i> 65	<i>Grams.</i> 3.8	<i>Calories.</i> 56
Cheese, sage (91), 1, 1 cent; butter (87), 41, 41 cents; milk, glass (95), 15, 30 cents; milk, bowl (hot) (94), 1, 5 cents; milk, 4-ounce pitchers (96), 30, 30 cents. Total dairy products.....	5.1	10.7	413	10.4	384
Prepared cereal (97), 2, 8 cents; hominy (100), 2, 8 cents; oatmeal (103), 21, 84 cents; rice (106), 5, 20 cents. Total breakfast cereals, etc.....	5.7	9.6	297	8.2	270
Bread, white (113), 13, 13 cents; bread, Graham (116), 89, 89 cents; bread, Boston brown (122), 6, 12 cents; Graham gems (130), 8, 8 cents; crackers for soup (152), 15, 15 cents; bread, corn (119), 5, 5 cents; rolls (131), 6, 6 cents; biscuit (125), 8, 8 cents. Total breads, crackers, etc.....	7.4	41.4	1,429	35.2	1,300
Cake (158), 4, 8¢ cents; gingerbread (168), 1, 1 cent; pie (172), 2, 10 cents. Total desserts, etc.....	.9	1.3	91	1.1	85
Potatoes, baked (199), 11, 22 cents; sweet potatoes (216), 4, 8 cents; succotash (230), 1, 3 cents. Total vegetables.....	1.6	3.1	156	2.6	142
Bananas (245), 1, 2 cents; oranges (252), 2, 6 cents. Total fruits.....	.4	.2	13	.2	11
Sugar, teaspoonfuls (259), 140, 0¢.....			237		232
Cereal coffee (264), 5, 15 cents; cocoa (262), 9, 27 cents. Total beverages.....	2.0	1.0	27	1.0	27
Combination lunches (271), 6, 60 cents; dinners (274), 6, 72 cents. Total combination meals.....	6.3	16.7	479	15.4	441
Total food.....	31.5	87.9	3,207	77.9	2,948
<i>Period 2, 3 weeks, February 14 to March 6.</i>					
Beefsteak pie (26), 1, 10 cents.....	.5	1.8	33	1.8	29
Chowder (57), 1, 3 cents; soup (60), 3, 9 cents. Total soups, etc.....	.6	.9	14	.9	12
Butter (88), 45, 45 cents; milk, glass (95), 17, 34 cents; milk, 4-ounce pitchers (96), 39, 39 cents. Total dairy products.....	5.6	12.1	462	11.7	430
Prepared cereal (98), 9, 36 cents; oatmeal (104), 21, 63 cents; rice (107), 2, 6 cents; wheat (110), 7, 21 cents. Total breakfast cereals, etc.....	6.0	9.7	313	8.2	285
Bread, Graham (117), 103, \$1.03; bread, Boston brown (123), 5, 10 cents; biscuit (126), 2, 2 cents. Total bread, crackers, etc.....	5.5	33.3	1,110	28.3	1,010
Pie (173), 1, 5 cents; tarts (181), 1, 2 cents. Total desserts.....	.3	.4	33	.3	31
Potatoes, baked (200), 9, 18 cents; potatoes, boiled (202), 1, 2 cents; sweet potatoes (217), 11, 22 cents. Total vegetables.....	2.0	4.7	276	3.9	251
Oranges (250), 20, 60 cents.....	2.9	1.3	82	1.1	72
Sugar, teaspoonfuls (259), 146, 0¢.....			247		242
Cocoa (262), 12, 36 cents; coffee (263), 1, 3 cents. Total beverages.....	1.9	1.2	34	1.2	33
Combination lunches (272), 11, \$1.10; dinners (275), 2, 24 cents. Total combination meals.....	6.4	19.6	587	18.0	540
Total food.....	31.7	85.0	3,191	75.4	2,935
<i>Period 3, 3 weeks, May 8 to May 28.</i>					
Beef, roast (8), 3, 30 cents.....	1.4	3.0	39	2.9	34
Eggs, dropped (77), 10, 30 cents; eggs, fried (80), 1, 3 cents; eggs, scrambled (86), 1, 8 cents; egg omelet (83), 1, 8 cents. Total eggs.....	2.3	6.3	106	6.1	94
Chowder (57), 3, 9 cents; soup (61), 3, 9 cents. Total soups, etc.....	.9	1.7	32	1.6	28
Cream (with strawberries) (93), 1, 0, ^b butter (89), 35, 35 cents; milk, glass (95), 1, 2 cents; milk, bowl (94), 14, 56 cents; milk, 4-ounce pitchers (96), 31, 31 cents. Total dairy products.....	5.9	13.9	471	13.5	458
<i>a</i> See footnote <i>h</i> to Table 1. <i>b</i> See footnote <i>r</i> to Table 1. <i>c</i> Orders for one-half the usual amount.					

TABLE 3.—*Kinds of food, number of orders, and cost of each kind, and average cost and amounts of protein and energy of dietary study No. 401—Continued.*

SUBJECT A—Continued.

Kinds of food, number of orders, and cost of each kind.	Cost, protein, and energy of daily food.				
	Total.			Digestible protein.	Available energy.
	Cost.	Protein.	Energy.		
<i>Period 3, 3 weeks, May 8 to May 28—Continued.</i>					
Prepared cereal (99), 2, 8 cents; hominy (102), 1, 3 cents; oatmeal (105), 21, 63 cents; rice (108), 5, 15 cents; shredded wheat (109), 1, ^a 2 cents; wheat (111), 4, 12 cents. Total breakfast cereals, etc.	<i>Cents.</i> 4.9	<i>Grams.</i> 9.6	<i>Calories.</i> 302	<i>Grams.</i> 8.2	<i>Calories.</i> 275
Bread, white (115), 2, 2 cents; bread, Graham (118), 98, 98 cents; bread, brown (124), 2, 4 cents; bread, corn (121), 1, 1 cent; biscuit (127), 2, 2 cents; grid-dlecakes (146), 1, 4 cents; toast, creamed (138), 1, 6 cents; crackers for soup (154), 1, 1 cent. Total bread, crackers, etc.	5.6	30.5	999	25.9	909
Cake (160), 4, 4 cents; ice cream (184), 1, 7 cents; pie (174), 2, 8 cents; pudding (177), 4, 16 cents. Total desserts.	1.7	2.7	147	2.3	137
Beans, baked (191), 2, 8 cents; potatoes, boiled (202), 1, 2 cents; potatoes, hashed (214), 1, 2 cents; potatoes, mashed (205), 3, 6 cents. Total vegetables.	.9	2.5	79	2.1	72
Bananas (244), 3, 6 cents; oranges (251), 6, 18 cents; strawberries (with cream) (256), 1, 7 cents. Total fruits.	1.5	.5	41	.4	36
Sugar, teaspoonfuls (259), 150, 0; ^b sirup (260), 1, 2 cents. Total sugar, etc.	.1	.....	264	.....	259
Cocoa (262), 10, 30 cents; lemonade (267), 2, 4 cents; tea (263), 1, 3 cents. Total beverages.	1.8	1.0	37	1.0	36
Combination lunches (273), 8, 80 cents; dinners (276), 5, 60 cents. Total combination meals.	6.6	12.2	409	11.2	376
Total food.	33.6	83.9	2,926	75.2	2,694
Average for three periods.	32.3	85.6	3,108	76.2	2,859

^aOrder for one-half the usual amount.^bSee footnote *r* to Table 1.

In regard to the diet of this subject, the most striking feature is the exceedingly small amount of meat, eggs, and fish eaten, roughly about 35 per cent of the digestible protein being derived from animal foods and 65 per cent from vegetable foods. In period 1 no meat, fish, eggs, or hash was eaten except that served in the combination meals, and such meals amounted to but a small fraction of the total diet, furnishing only about 20 per cent of the total digestible protein and 15 per cent of the total available energy.

In periods 2 and 3 the protein furnished by the meat eaten, aside from that of the combination meals, was also low, amounting to only about 2.5 to 4 per cent of the total. Eggs were eaten only in period 3, and then in double the average amount. The small amounts of meats, fish, and hash eaten by Subject A are very noticeable when comparison is made with the average for the ten subjects included in this investigation. In such an average about 13 per cent of the total cost of the average diet was for meats, fish, and hash, which furnished about 17 per cent of the total digestible protein and 5.5 per cent of the total available energy, whereas Subject A spent about 2 per cent of his total outlay on meats, fish, and hash, yielding about 2 per

cent of the total digestible protein and less than 1 per cent of the total available energy. At the same time the sum spent by Subject A on cereals and on soups was about 100 per cent, and on breadstuffs 33 per cent more than the average of the subjects studied, while his expenditure for desserts was about 50 per cent and for vegetables and for beverages about 70 per cent of the average. It should be mentioned that, owing to the choice of the cheapest foods, he obtained for 1 cent spent on breadstuffs nearly 25 per cent more nutrients and on vegetables about 15 per cent more than the average for all the men studied. With the other classes of food he bought for 1 cent not far from the average amounts.

It has been pointed out that about 65 per cent of the protein was of vegetable origin. It is further true that breads and cereals together furnished by far the larger part of this protein (over 50 per cent of the total in the diet) and a like proportion of energy, the amounts from vegetables proper and fruits being very small, about 3 or 4 per cent.

The total digestible protein in the diet for the three periods averages 76.2 grams, or about 83 per cent of the commonly accepted standard for a man of sedentary habits, namely, 92 grams of digestible protein. On the other hand, the available energy averages 2,859 calories, or rather more than the standard calls for, i. e., 2,700 calories of available energy. The quantity of protein was remarkably uniform through the three periods (fall, winter, and spring), but the energy dropped from about 2,940 calories (average of fall and winter) to 2,694 calories in the spring term.

The small sum (about one-half as much as the average) spent on desserts is wise, since such foods would have furnished little protein and energy in proportion to their cost; but the 6 per cent of the average outlay per day spent on beverages might have been avoided with advantage and the sum expended for more nourishing foods. Milk is not included under the head of beverages, but appears under "dairy products." It is an economical food.

Subject A led throughout the year a regular life, with constant application to his university work. His diet was practically constant, being unusually low in protein and almost vegetarian in character. At the end of the investigation, May, 1901, he showed a gain of 7.5 pounds. As may be seen from Table 16, his general strength, as shown on the machines, and his chest, waist, and thigh measurements increased proportionately. At the beginning of the study he was classed after examination as underdeveloped and undernourished. At the end no marked change showed itself other than the increase in bodily weight. His intellectual efforts, if we may judge from the grades attained in his studies (see Table 18, p. 61), were attended with success above the

ordinary. In other words, the diet of Subject A, although very low in protein and about equal to the average as regards energy, appears to have been a little more than sufficient to maintain him in equilibrium with his environment, which was essentially one calling for intellectual and not physical work.

DIETARY STUDY NO. 402.

Subject B was 20 years of age, 5 feet 3.6 inches in height, and weighed 131.8 pounds. In general development he was apparently not far from the average of his age, although in point of nutrition he was classed among the fairly well nourished. He was a freshman in the college, and Latin, German, French, history, and physics all found a place in the course he selected for the year. To his college duties he devoted 7 to 8 hours per day, including lectures, reading, and preparation. He slept 7 to 8 hours. In the fall he walked or played football one hour every other day on an average. In the winter he walked from 30 minutes to 1 hour every other day, and in the spring he played baseball for 30 minutes to 2 hours with about the same frequency. In addition to his studies and exercise, during period 1 he worked in a barber shop at odd times, and during period 2 he added to this programme by serving as a student waiter at Randall Hall for one or two hours daily for about a week. In period 3, the spring period, he did no work outside of his academic course.

TABLE 4.—*Kinds of food, number of orders, and cost of each kind, and average cost and amounts of protein and energy of dietary study No. 402.*

SUBJECT B.

[For explanation of numbers in parentheses see p. 11.]

Kinds of food, number of orders, and cost of each kind.	Cost, protein, and energy of daily food.				
	Total.			Digestible protein.	Available energy.
	Cost.	Protein.	Energy.		
<i>Period 1, 3 weeks, November 30 to December 20.</i>					
Beef, roast (6), 2, 20 cents; beef, pressed corned (5), 1, 8 cents; potpie (25), 1, 10 cents; beef hash (20), 5, 35 cents; pork chops (42), 1, 10 cents. Total meats, etc.....	<i>Cents.</i> 4.0	<i>Grams.</i> 12.2	<i>Calories.</i> 213	<i>Grams.</i> 11.8	<i>Calories.</i> 185
Chowder (57), 1, 3 cents; soups (59), 2, 6 cents. Total soups, etc.....	.4	.8	14	.8	12
Smelts, fried (65), 1, 10 cents.....	.5	1.5	11	1.5	9
Eggs, dropped (77), 1, 8 cents; eggs, with toast (77), 2, 16 cents; egg omelet (81), 1, 10 cents. Total eggs.....	1.6	2.8	42	2.7	37
Butter (87), 27, 27 cents; cheese (90), 5, 5 cents; milk, bowl (94), 9, 36 cents; milk, glass (95), 3, 6 cents; milk, 4-ounce pitchers (96), 12, 12 cents. Total dairy products.....	4.1	9.5	322	9.2	299
Hominy (100), 7, 28 cents; oatmeal (103), 2, 8 cents; rice (106), 1, 4 cents; wheat (112), 2, 8 cents. Total cereals.....	2.3	2.6	102	2.2	93
Bread, white (113), 34, 34 cents; bread, Graham (116), 9, 9 cents; bread, corn (119), 17, 17 cents; rolls (131), 14, 14 cents; toast (134), 1, 2 cents; toast (with eggs) (140), 2, 4 cents; toast, buttered (137), 1, 3 cents; crackers, for soup (152), 24, 24 cents; buckwheat cakes (143), 2, 10 cents. Total bread, crackers, etc.....	5.6	25.5	881	21.7	802
Cake (158), 2, 2 cents; pudding, plum (175), 1, 5 cents. Total desserts.....	.3	.7	34	.6	32

TABLE 4.—*Kinds of food, number of orders, and cost of each kind, and average cost and amount of protein and energy of dietary study No. 402.*—Continued.

SUBJECT B—Continued.

Kinds of food, number of orders, and cost of each kind.	Cost, protein, and energy of daily food				
	Total.			Digestible protein.	Available energy.
	Cost.	Protein.	Energy.		
<i>Period 1, 3 weeks, November 20 to December 20—Cont'd.</i>					
Beans, baked (189), 15, 60 cents; potatoes, fried (207), 1, 2 cents; potatoes, lyonnaise (211), 2, 4 cents; sweet potatoes (216), 1, 2 cents; hash, vegetable (236), 1, 6 cents. Total vegetables.....	<i>Cents.</i> 3.5	<i>Grams.</i> 13.3	<i>Calories.</i> 300	<i>Grams.</i> 11.0	<i>Calories.</i> 273
Sirup (260), 2, 4 cents; sugar, teaspoonfuls (259), 216, 0c. Total sugars, etc.....	.2	.....	385	.....	377
Cereal coffee (264), 3, 9 cents; cocoa (262), 3, 9 cents; coffee (263), 7, 21 cents; tea (263), 9, 27 cents. Total beverages.....	3.1	1.4	34	1.4	33
Combination breakfasts (268), 4, 40 cents; lunches (271), 9, 90 cents; dinners (274), 11, \$1.32. Total combination meals.....	12.5	33.0	928	30.4	854
Total food.....	38.1	103.3	3,266	93.3	3,006
<i>Period 2, 3 weeks, February 14 to March 6.</i>					
Beef tongue (16), 1, 10 cents; beef, tripe (17), 1, 10 cents; beef hash (21), 4, 28 cents; beefsteak pie (26), 4, 40 cents. Total meats, etc.....	4.2	12.5	207	12.1	180
Chowder (57), 2, 6 cents; purée of peas (58), 1, 3 cents. Total soups, etc.....	.4	.9	21	.9	18
Eggs (with toast) (77), 3, 24 cents.....	1.1	1.9	24	1.8	21
Butter (88), 22, 22 cents; cream (92), 1, 2 cents; milk, bowl (94), 11, 44 cents; milk, glass (95), 15, 30 cents; milk, 4-ounce pitchers (96), 14, 14 cents. Total dairy products.....	5.3	13.7	397	13.3	369
Prepared cereals (98), 5, 20 cents; hominy (101), 3, 9 cents; oatmeal (104), 2, 6 cents; rice (107), 3, 9 cents; wheat (110), 2, 6 cents. Total breakfast cereals.....	2.4	3.5	131	3.0	119
Bread, white (114), 30, 30 cents; bread, Graham (117), 1, 1 cent; bread, corn (120), 39, 39 cents; bisquit (126), 2, 2 cents; gems, Graham (128), 2, 2 cents; rolls (132), 15, 15 cents; toast, buttered (135), 2, 6 cents; toast (with eggs) (140), 3, 6 cents; scones (142), 1, 1 cent; macaroni (157), 1, 7 cents; griddle-cakes (145), 1, 5 cents. Total bread, crackers, etc.....	5.4	22.0	749	18.7	682
Cake (159), 1, 1 cent; gingerbread (169), 4, 4 cents; pie (173), 1, 5 cents. Total desserts.....	.5	1.0	64	.9	60
Beans, baked (190), 5, 20 cents; potatoes, lyonnaise (213), 1, 2 cents. Total vegetables.....	4.0	4.6	93	3.8	85
Bananas (243), 9, 18 cents.....	.9	.5	43	.4	38
Sirup (260), 1, 2 cents; sugar, teaspoonfuls (259), 236, 0c. Total sugars, etc.....	.1	.....	409	.....	401
Cocoa (262), 1, 3 cents; coffee (263), 4, 12 cents; tea (263), 1, 3 cents. Total beverages.....	.9	.4	10	.4	40
Combination breakfasts (269), 8, 80 cents; lunches (272), 6, 60 cents; dinners (275), 8, 96 cents. Total combination meals.....	11.3	30.4	854	27.7	786
Total food.....	33.5	94.1	3,002	83.0	2,769
<i>Period 3, 3 weeks, May 8 to May 28.</i>					
Beef, roast (8), 4, 40 cents; beefsteak (12), 1, 10 cents; beef hash (22), 1, 6 cents; lamb, minced (with toast) (38), 1, 8 cents; pork, chops (42), 2, 20 cents. Total meats, etc.....	4.0	12.2	224	11.8	195
Chowder (57), 1, 3 cents; soups (61), 4, 12 cents. Total soups, etc.....	.7	1.4	24	1.4	21
Mackerel (64), 5, 50 cents.....	2.4	7.5	62	7.3	53
Eggs (with toast) (77), 2, 12 cents.....	.6	1.2	16	1.2	14
Butter (89), 14, 14 cents; cream (92), 10, 20 cents; milk, bowl (94), 9, 36 cents; milk, glass (95), 3, 6 cents; milk, 4-ounce pitchers (96), 2, 2 cents. Total dairy products.....	3.7	7.3	272	7.1	253
Prepared cereal (99), 1, 4 cents; hominy (102), 3, 9 cents; oatmeal (105), 2, 6 cents; rice (108), 5, 15 cents; wheat (111), 2, 6 cents. Total breakfast cereals, etc.....	4.9	2.8	111	2.4	101

^a See footnote 1 to Table 1.

TABLE 4.—*Kinds of food, number of orders, and cost of each kind, and average cost and amounts of protein and energy of dietary study No. 402—Continued.*

SUBJECT B—Continued.

Kinds of food, number of orders, and cost of each kind.	Cost, protein, and energy of daily food.				
	Total.			Digestible protein.	Available energy.
	Cost.	Protein.	Energy.		
<i>Period 3, 3 weeks, May 8 to May 28—Continued.</i>					
Bread, white (115), 27, 27 cents; bread, Graham (118), 3, 3 cents; bread, corn (121), 20, 20 cents; gems, Graham (129), 1, 1 cent; rolls (133), 18, 18 cents; toast, buttered (136), 2, 6 cents; toast (with eggs and with lamb) (140), 3, 6 cents; griddlecakes (146), 2, 8 cents; macaroni (156), 2, 12 cents. Total breads, crackers, etc.....	<i>Cents.</i> 4.8	<i>Grams.</i> 19.8	<i>Calories.</i> 650	<i>Grams.</i> 16.8	<i>Calories.</i> 592
Cake, chocolate (160), 1, 1 cent; pudding, Indian (178), 1, 4 cents; pie (174), 6, 24 cents; ice cream (184), 1, 7 cents. Total desserts.....	1.7	2.4	160	2.0	149
Beans, baked (191), 4, 16 cents; beets, pickled (219), 1, 3 cents; potatoes, baked (201), 2, 4 cents; potatoes, boiled (202), 4, 8 cents; potatoes, German fried (210), 2, 4 cents; potatoes, lyonnaise (212), 1, 2 cents; radishes (228), 1, 4 cents. Total vegetables.....	2.0	4.9	141	4.1	128
Bananas (244), 3, 6 cents; oranges (251), 1, 3 cents. Total fruits.....	.4	.2	17	.2	15
Sirup (260), 5, 10 cents; sugar, teaspoonfuls (259), 212, 0. <i>a</i> Total sugars, etc.....	.5	.....	408	.....	400
Cocoa (262), 1, 3 cents; coffee (263), 2, 6 cents; lemonade (267), 3, 6 cents; tea (263), 15, 45 cents. Total beverages.....	2.9	1.3	41	1.3	40
Combination breakfasts (270), 4, 40 cents; lunches (273), 11, \$1.10; dinners (276), 7, 84 cents. Total combination meals.....	11.1	21.5	706	19.8	650
Total food.....	36.7	82.5	2,832	75.4	2,611
Average for three periods.....	36.1	92.3	3,033	83.9	2,795

^a See footnote *r* to Table 1.

With a normal average diet as a basis of comparison there is nothing especially noticeable in regard to the total amounts of protein and energy in the dietary of Subject B. As regards the amount of meat, fish, and hash eaten, he spent 14 per cent of his daily outgo, exclusive of combination meals, on such foods, which is practically identical with the average for the ten men studied. In other words, the proportion of protein furnished by animal foods was 56 per cent of the total, and the energy furnished by vegetable foods about 65 per cent. The ratio of digestible protein from animal to that from vegetable sources in the average American diet has been found to be about 60 to 40 per cent, in round numbers, and the corresponding ratio for available energy 43 to 57 per cent. It is evident that the diet of this subject furnished nearly the usual proportion of animal and vegetable foods. The number of combination meals eaten was large, the amount spent for these being almost twice as great as the average for the ten men.

In the case of meats, soups, breads, dairy products, and beverages the proportional daily expenditure was very close to the average. For eggs, cereals, and vegetables it was, roughly, 75 per cent of the

average, and for desserts and fruits about 35 and 25 per cent, respectively. If one's tastes permit it, this is a considerable economy, since neither desserts nor fruits furnish nutrients at a low cost. It is noticeable that liberal use was made of sugar, which, as already pointed out, was supplied without extra charge. The subject thus dispensed with the usual expenditure for sirups, etc. For the whole dietary, the quantities of digestible protein and available energy show a steady decrease toward a minimum in period 3. The average for the three periods was 84 grams digestible protein and 2,795 calories of available energy, or 91.5 and 103.5 per cent, respectively, of the quantities in the commonly accepted dietary standard for a man of sedentary habits.

Although the quantities of protein and energy in the last period were 9 and 6 per cent lower, respectively, than in period 2, the cost was about 3.3 cents, or 10 per cent higher, owing in part to a greater proportionate expenditure for fish, desserts, and beverages, which were all relatively expensive foods. A corresponding deficit occurs in the case of dairy products, cereals, and breads. Perhaps a more potent factor in this drop in the value of the ration during period 3 was the diminished buying power of 1 cent when expended on some of the more important articles. Calculations show, for example, that for 1 cent spent on combination meals in period 2, Subject B obtained 2.5 grams of digestible protein and 69.5 calories of available energy, whereas in period 3 he obtained only 1.8 grams and 58.5 calories, or, respectively, 72 per cent and 83 per cent as much. When we remember that the combination meals furnished about 30 per cent of the total nutrients, it is evident that the effect of their use on total cost must be considerable.

Since a similar falling off in the amounts of nutrients without proportionate decrease in cost was noticed not only in this particular case, but in the majority of the dietaries here reported, it is difficult to account for it on the assumption of less prudent selection of food by the men during the last period. It seems more probable that there was a gradual rise in the price of the dishes toward the end of the year, or, what amounts to the same thing, a general diminution in the weights or the proportion of nutrients in the orders.

At the end of the spring period (period 3) Subject B weighed 136 pounds, or 4.2 pounds more than at the beginning of the study. A corresponding slight increase was observed in his anthropometric measurements. His general strength as shown by the testing machines increased less than the average. In point of general physical condition no material change was noted.

As regards mental work the grades attained in his examinations were about those of the average student. However, for a man with many

other duties besides those pertaining to his college course, they were creditable.

In Subject B, then, we have a young man, rather more active than the average, apparently in equilibrium with the demands of an academic life, and living on a ration which is practically identical with the standard chosen for comparison. It may be remarked that the gain in body weight (about 4 pounds) seems small when we remember that he was but 20 years old, and, therefore, probably still developing physically. It may be that his diet was not liberal enough to provide both for the energy involved in his daily life and for the material demanded by the growing body.

DIETARY STUDY NO. 403.

The subject of this study was 23 years old, 5 feet 6.1 inches in height, and weighed 145 pounds. In general development he was not far from the average. Medical examination showed that he was only fairly well nourished. Doubtless this condition was the result of a severe illness contracted during the preceding summer vacation.

Subject C was entirely dependent upon his own efforts for support and was, therefore, obliged to spend much time on outside work. He earned his lodging by attending to the furnace in a private house, and by serving from 1 to 3 hours daily as a waiter at Randall Hall he earned his board. He spent from 10 to 12 hours per day at intellectual work, including lectures, study, outside clerical work, and reading. For sleep he set aside 7 hours. During periods 1 and 2, the only physical exercise other than that involved in walking to and from lectures, meals, etc., that he found time for, was a 3-hour walk every Sunday afternoon. During period 3 he rode a bicycle 1 hour per day for 11 out of the 21 days.

Subject C was a sophomore in the college department of the university. His studies comprised German, philosophy, zoology, hygiene, physics, and chemistry, and he carried one whole course and one half course more than are regularly required of sophomores. Such a plan of study would be considered rather severe even for a student with no outside work.

TABLE 5.—*Kinds of food, number of orders, and cost of each kind, and average cost and amounts of protein and energy of dietary study No. 404.*

SUBJECT C.

[For explanation of numbers in parentheses, see p. 11.]

Kinds of food, number of orders, and cost of each kind.	Cost, protein, and energy of daily food.				
	Total.			Digestible protein.	Available energy.
	Cost.	Protein.	Energy.		
<i>Period 1, 3 weeks, November 30 to December 30.</i>					
Beef hash (20), 1, 7 cents; pork, bacon (with eggs) (39), 1, 4 cents. Total meats, etc.....	<i>Cents.</i> 0.5	<i>Grams.</i> 1.3	<i>Calories.</i> 25	<i>Grams.</i> 1.3	<i>Calories.</i> 22
Purée of peas (58), 3, 9 cents; soup (59), 1, 3 cents. Total soups.....	.6	1.3	31	1.3	27
Eggs, fried (with bacon) (78), 1, 8 cents; fried (78), 1, 4 cents; egg omelet (81), 1, 10 cents; eggs, scrambled (84), 1, 10 cents. Total eggs, etc.....	1.5	3.7	76	3.6	68
Butter (87), 22, 22 cents; milk, glass (95), 33, 66 cents; milk, 4-ounce pitchers (96), 2, 2 cents. Total dairy products.....	4.3	10.8	332	10.5	309
Prepared cereals (97), 1, 4 cents; oatmeal, (103), 2, 8 cents; shredded wheat (109), 5, 20 cents. Total breakfast cereals.....	1.5	2.5	87	2.1	79
Bread, Graham (116), 55, 55 cents; bread, corn (119), 11, 11 cents; rolls (131), 4, 4 cents; griddlecakes (147), 1, 5 cents; macaroni (155), 2, 14 cents. Total bread, crackers, etc.....	4.2	19.9	643	16.9	585
Gingerbread (168), 1, 1 cent; pie (172), 1, 5 cents; coffee jelly (185), 1, 4 cents; ice cream (182), 1, 7 cents. Total desserts, etc.....	.8	.7	50	.6	47
Beans, baked (189), 2, 8 cents; beans, Lima (192), 3, 9 cents; celery (222), 2, 10 cents; potatoes, baked (199), 4, 8 cents; potatoes, hashed (214), 1, 2 cents; sweet potatoes (216), 9, 18 cents; succotash (230), 1, 3 cents. Total vegetables.....	2.8	6.1	266	5.1	242
Oranges (252), 1, 3 cents.....	.1	.1	4	.1	4
Syrup (260), 1, 2 cents; sugar, teaspoonfuls (259), 43, 0.6 Total sugars, etc.....	.1	.....	83	.....	81
Coffee (263), 17, 51 cents.....	2.4	.1	25	.1	25
Combination breakfasts (268), 13, \$1.30; lunches (271), 18, \$1.80; dinners (274), 11, \$1.32. Total combination meals.....	21.1	55.5	1, 622	51.1	1, 492
Total food.....	39.9	102.0	3, 244	92.7	2, 981
<i>Period 2, 3 weeks, February 14 to March 6.</i>					
Beef stew (9), 1, 10 cents; beef hash (21), 3, 21 cents; pork, bacon (with eggs) (40), 1, 4 cents. Total meats, etc.....	1.7	7.1	91	6.9	79
Eggs (with bacon) (79), 1, 8 cents; eggs, scrambled (85), 1, 10 cents. Total eggs, etc.....	.9	2.2	47	2.1	42
Butter (88), 33, 33 cents; milk, glass (95), 8, 16 cents; milk, 4-ounce pitchers (96), 13, 13 cents. Total dairy products.....	2.9	4.9	251	4.8	233
Oatmeal (104), 4, 12 cents; rice (107), 1, 3 cents; shredded wheat (109), 5, 20 cents. Total breakfast cereals.....	1.7	2.5	88	2.1	80
Bread, white (114), 9, 9 cents; bread, Graham (117), 54, 54 cents; bread, corn (120), 10, 10 cents; biscuit (126), 1, 1 cent; rolls (132), 2, 2 cents; scones (142), 1, 1 cent. Total bread, crackers, etc.....	3.7	21.3	694	18.1	632
Gingerbread (169), 5, 5 cents; eclairs (167), 1, 4 cents; pie (173), 3, 15 cents; coffee jelly (186), 10, 40 cents. Total desserts, etc.....	3.0	3.3	177	2.8	165
Beans, baked (190), 2, 8 cents; beans, Lima (193), 1, 3 cents; peas (196), 3, 9 cents; potatoes, baked (200), 5, 10 cents; sweet potatoes (217), 16, 32 cents; cabbage (220), 2, 6 cents; corn, stewed (224), 4, 12 cents; pickles (238), 5, 5 cents; spinach (229), 1, 2 cents. Total vegetables.....	4.1	8.4	401	7.0	365
Bananas (243), 5, 10 cents; oranges (250), 7, 21 cents. Total fruits.....	1.5	.9	64	.8	56
Sugar, teaspoonfuls (259), 57, 0.6.....	.....	.....	96	.....	94
Cereal coffee (264), 2, 6 cents; cocoa (262), 2, 6 cents; coffee (263), 27, 81 cents. Total beverages.....	4.4	2.1	47	2.0	46
Combination breakfasts (269), 11, \$1.10; lunches (272), 16, \$1.60; dinners (275), 8, 96 cents. Total combination meals.....	17.4	48.9	1, 440	45.0	1, 325
Total food.....	41.3	101.6	3, 396	91.6	3, 117

^aOrder for one-half the usual amount.^bSee footnote r to Table 1.

TABLE 5.—*Kinds of food, number of orders, and cost of each kind, and average cost and amounts of protein and energy of dietary study No. 403—Continued.*

SUBJECT C—Continued.

Kinds of food, number of orders, and cost of each kind.	Cost, protein, and energy of daily food.				
	Total.			Digestible protein.	Available energy.
	Cost.	Protein.	Energy.		
<i>Period 3, 3 weeks, May 8 to May 28.</i>					
Beef, roast (8), 5, 50 cents; beef stew (9), 1, 10 cents; beef hash (22), 3, 18 cents; beef, corned (4), 2, 16 cents; hash of ham and eggs (47), 1, 10 cents. Total meats, etc.....	<i>Cents.</i> 5.0	<i>Grams.</i> 18.0	<i>Calories.</i> 229	<i>Grams.</i> 17.5	<i>Calories.</i> 199
Purée of peas (58), 3, 9 cents; soup (61), 2, 6 cents. Total soups, etc.....	.7	1.7	34	1.6	29
Eggs, scrambled (86), 1, 8 cents; eggs, dropped (77), 1, 6 cents. Total eggs.....	.7	2.6	52	2.5	46
Cream (with strawberries) (93), 1, 0; ^a milk, glass (95), 5, 10 cents; milk, 4-ounce pitchers (96), 10, 10 cents; butter (89), 38, 38 cents. Total dairy products.....	2.7	3.5	261	3.4	243
Prepared cereals (99), 1, 4 cents; oatmeal (105), 1, 3 cents; wheat (111), 7, 21 cents. Total breakfast cereals.....	1.3	2.3	79	2.0	72
Bread, white (115), 1, 1 cent; bread, Graham (118), 60, 60 cents; bread, corn (121), 8, 8 cents; griddle-cakes (146), 2, 8 cents; macaroni (156), 2, 12 cents; scones (142), 3, 3 cents. Total bread, crackers, etc.....	4.4	21.0	684	17.9	622
Cookies (163), 2, 2 cents; cake (160), 6, 6 cents; pie (174), 6, 24 cents; pudding (177), 2, 8 cents; short-cake, crust (180), 2, 0; ^a shortcake, strawberries (179), 2, 15 cents; coffee jelly (187), 1, 4 cents; ice cream (184), 3, 21 cents. Total desserts, etc.....	3.8	5.0	315	4.3	293
Beans, Lima (194), 5, 10 cents; beans, wax (195), 1, 2 cents; beans, baked (191), 1, 4 cents; cabbage (221), 3, 6 cents; corn (225), 6, 12 cents; peas (197), 1, 2 cents; pickles (239), 2, 2 cents; potatoes, stewed (206), 1, 2 cents; potatoes, baked (201), 4, 8 cents; potatoes, mashed (205), 6, 12 cents; radishes (228), 1, 4 cents; succotash (231), 5, 10 cents; tomatoes (233), 1, 2 cents; turnips (235), 1, 2 cents. Total vegetables, etc.....	3.7	6.3	209	5.2	190
Apples (240), 3, 6 cents; bananas (244), 7, 14 cents; oranges (251), 17, 51 cents; strawberries (256), 2, 15 cents. Total fruits.....	4.1	1.7	116	1.4	102
Sugar, teaspoonfuls (259), 54, 0; ^a sirup (260), 2, 4 cents. Total sugar, etc.....	.2	.....	111	.....	109
Coffee (263), 25, 75 cents; birch beer (266), 1, 5 cents; ginger ale (266), 2, 10 cents; lemonade (267), 7, 14 cents; sarsaparilla (266), 1, 5 cents. Total beverages.....	5.2	1.8	87	1.7	85
Combination breakfasts (270), 7, 70 cents; lunches (273), 16, \$1.60; dinners (276), 2, 24 cents. Total combination meals.....	12.1	23.3	819	21.4	753
Total food.....	43.9	87.2	2,948	78.9	2,743
Average of three periods.....	41.7	96.9	3,196	87.7	2,947

^a See footnote *r* to Table 1.

The average amount of digestible protein furnished by the diet selected by the subject is not far from the quantity called for by the standard selected for comparison, whereas in general the amount of energy was somewhat higher than the standard called for. About 54 per cent of the total digestible protein and 34 per cent of the available energy in the average diet of Subject C came from animal food. It is noticeable that nearly 40 per cent of the nutrients in the average ration for the three periods was furnished by the combination meals. In other words, he lived half on foods which he selected and half on meals selected by the commons management. The use of many com-

bination meals explains the fact that a number of important classes of food appear in quantities considerably below the average. For example, separate orders of meats and cereals were eaten in about one-half the average amounts, and dairy products, eggs, and breads in about 65 per cent of the average amounts. Besides combination meals, the only articles chosen in quantities greater than the average for the ten men studied were vegetables and beverages (chiefly coffee), both of which were about 20 per cent above the average. On the basis of economy so much coffee was not a wise selection, since its value as a source of nutrients and energy is very small in proportion to the cost and due chiefly to the milk and sugar which are added to it. In this dietary, therefore, about 9.5 per cent of the total sum was expended for articles yielding only about 1.5 per cent of the total digestible protein and available energy. This is noteworthy when it is remembered that 9.9 per cent of the total outlay was for breadstuffs, which yielded 20 per cent of the total protein and energy.

For the first two periods, fall and winter, the rations were more abundant than later, furnishing on an average 92.1 grams of digestible protein and 3,049 calories of available energy, or 100 per cent and 113 per cent, respectively, of the values called for by the standard selected for comparison. In period 3, however, the protein dropped to 78.9 grams and the energy to 2,743 calories (86 and 101 per cent, respectively, of the standard), while the cost increased to 43.9 cents, or about 8.5 per cent more than the average for the first two periods. It is evident that, as compared with the subjects already noted, Subject C was not getting a large return for his investment. He might have secured the same amount of protein and energy if he had selected a larger proportion of foods similar to those chosen by Subjects A and B.

The chief reason for the sudden drop in the nutritive value of the ration of Subject C, in spite of the higher daily cost, is undoubtedly to be found in the tendency to use meats and fruits—both relatively expensive foods at Randall Hall—in place of combination meals. It should be noted that in period 3 he obtained in 1 cent's worth of vegetables only about 0.8 of the protein and 0.6 of the energy that 1 cent's worth of vegetables furnished in periods 1 and 2. Similarly, for the same sum, the combination meals yielded only 0.7 to 0.8 as much as in periods 1 and 2. Of the two conceivable causes of this condition (higher relative cost and less wise choice of dishes during period 3), it seems probable that higher cost was responsible for the lower value per money unit of the combination meals and that a more liberal use of green spring vegetables was responsible for the lower value of vegetables per money unit. In some measure, then, it appears that the ration of Subject C during period 3 must necessarily have been lower per money unit because the scale of prices had changed, and, conse-

quently, no redistribution of the cost items would bring exactly the same value as was secured in periods 1 and 2 for the same sum.

At the end of the study Subject C weighed 143 pounds, or 2 pounds less than at the beginning of the investigation, some seven months previous. The anthropometric measurements showed very small changes, but, as shown by the strength tests, the subject gained rather more than the average, indicating a slight improvement in muscular condition. Medical examination showed no marked change in his general physical condition.

In his college work Subject C attained a grade between B and C, which may be considered slightly above the average. Remembering that he carried 6 courses, instead of the usual $4\frac{1}{2}$, and that he supported himself by outside work, his performance was very creditable indeed.

The general average for the three periods shows 87.7 grams of digestible protein and 2,947 calories of available energy in the daily food. Although these figures are lower than they would have been if he had exercised the same prudence in the selection of economical dishes in the last period as he did in the first two periods, they are not very far from the commonly accepted standard for a man of sedentary habits, namely, 92 grams of digestible protein and 2,700 calories of available energy. It is not at all certain, however, that for a person of such active habits and long hours of duty the diet was in every way sufficient for the best functioning of brain and body. It is to be observed that, although Subject C had been seriously ill shortly before the beginning of the college year, his bodily weight was less at the end of the study than at the beginning, whereas the average gain of the 10 men studied was 4 per cent over their initial weights.

DIETARY STUDY NO. 404.

Subject D was 22 years old, 5 feet 6.5 inches in height, and weighed 119.5 pounds. In the usual physical examination he was classed as poorly developed and nourished. His bodily measurements, as well as his height, were considerably below the average for men of the same age.

A sophomore in the college, he devoted himself exclusively to mathematics and physics, carrying the usual 4 courses, of which one was on the subject of physics. He slept $6\frac{1}{2}$ to $7\frac{1}{4}$ hours per day. Of all the men studied, he devoted the greatest number of hours to his college work, the time thus spent amounting to $11\frac{1}{2}$ to $12\frac{3}{4}$ hours, or virtually the whole working day. He did no work outside of his college course and took practically no exercise, the sum total for the entire three periods amounting to only 30 minutes to 1 hour gymnasium work per day on 9 days.

TABLE 6.—*Kinds of food, number of orders, and cost of each kind, and average cost and amounts of protein and energy of dietary study No. 404.*

SUBJECT D.

[For explanation of numbers in parentheses, see p. 11.]

Kinds of food, number of orders, and cost of each kind.	Cost, protein, and energy of daily food.				
	Total.			Digestible protein.	Available energy.
	Cost.	Protein.	Energy.		
<i>Period 1, 3 weeks, November 30 to December 20.</i>					
Beefsteak (10), 8, 80 cents; pork, broiled ham (with eggs) (49), 2, 20 cents; ham cakes (44), 1, 10 cents. Total meats, etc.	<i>Cents.</i> 5.2	<i>Grams.</i> 15.0	<i>Calories.</i> 176	<i>Grams.</i> 14.6	<i>Calories.</i> 133
Oysters, fried (69), 1, 25 cents; oyster pie (73), 1, 12 cents; sea trout, fried (66), 1, 10 cents. Total fish, etc.	2.2	3.6	47	3.5	40
Eggs (with ham) (78), 2, 16 cents.	.8	1.1	22	1.1	20
Butter (87), 103, \$1.03; milk, glass (95), 40, 80 cents; milk, 4-ounce pitchers (96), 19, 19 cents; cream (92), 1, 2 cents. Total dairy products.	9.7	16.4	814	15.9	757
Hominy (100), 11, 44 cents; oatmeal (103), 1, 4 cents; rice (106), 8, 32 cents. Total breakfast cereals, etc.	3.8	3.7	166	3.1	151
Bread, white (113), 1, 1 cent; biscuit (125), 2, 2 cents; rolls (131), 36, 36 cents; toast, buttered (137), 21, 63 cents; buckwheat cakes (143), 3, 15 cents; griddlecakes (147), 5, 25 cents. Total breads, crackers, etc.	6.7	19.1	706	16.2	642
Coffee jelly (185), 1, 4 cents; cake (158), 2, 2 cents; doughnuts (164), 2, 2 cents; ice cream (182), 2, 14 cents; pudding (175), 3, 15 cents. Total desserts, etc.	1.8	2.1	117	1.8	109
Corn (223), 1, 3 cents; potatoes, baked (199), 7, 14 cents; potatoes, lyonnaise (211), 19, 95 cents; sweet potatoes (216), 6, 12 cents. Total vegetables.	5.9	5.6	344	4.7	313
Apples, baked (241), 1, 4 cents; bananas (245), 20, 40 cents; oranges (252), 4, 12 cents. Total fruits.	2.7	1.5	114	1.3	100
Sugar, teaspoonfuls (259), 50, 0; a sirup (260), 8, 16 cents. Total sugars, etc.	.8	.....	164	.....	161
Coffee (263), 3, 9 cents; cocoa (262), 1, 3 cents. Total beverages.	.6	.3	7	.3	7
Combination lunches (271), 1, 10 cents; dinners (274), 1, 12 cents. Total combination meals.	1.0	2.8	80	2.6	74
Total food.	41.2	71.2	2,757	65.1	2,527
<i>Period 2, 3 weeks, February 14 to March 6.</i>					
Beef, boiled (1), 1, 10 cents; beefsteak (11), 3, 50 cents; rump steak (14), 3, 60 cents; pork sausage (50), 1, 8 cents; chicken pie (51), 1, 12 cents. Total meats, etc.	6.7	19.7	242	19.1	211
Oysters, raw, 4 dozen (68), 2, 20 ^b cents; scallops, fried (74), 1, 10 cents; fish balls (76), 1, 5 cents. Total fish, etc.	1.7	2.8	28	2.7	24
Soups (60), 1, 3 cents.	.1	.2	3	.2	3
Butter (88), 94, 94 cents; cream (92), 28, 56 cents; milk, glass (95), 12, 24 cents; milk, 4-ounce pitchers (96), 15, 15 cents. Total dairy products.	9.0	9.0	738	7.7	686
Hominy (101), 12, 36 cents; rice (107), 3, 9 cents; shredded wheat (109), 14, 56 cents. Total breakfast cereals, etc.	4.8	6.4	268	5.4	244
Rolls (132), 26, 26 cents; toast, buttered (135), 13, 39 cents; buckwheat cakes (144), 2, 10 cents; griddlecakes (145), 6, 30 cents; crackers (153), 1, 1 cent. Total bread, crackers, etc.	5.1	14.0	508	11.9	462
Cake (159), 3, 3 cents; puddings (176), 2, 8 cents; sherbet (188), 1, 6 cents. Total desserts, etc.	.8	1.1	57	.9	53
Potatoes, baked (200), 2, 4 cents; potatoes, boiled (202), 1, 2 cents; potatoes, French fried (209), 9, 45 cents; potatoes, mashed (204), 1, 2 cents; potato salad (215), 1, 5 cents; sweet potatoes (217), 19, 38 cents; corn, stewed (224), 1, 3 cents. Total vegetables.	1.7	7.2	470	6.0	428
Apples, baked (241), 1, 4 cents; bananas (243), 13, 26 cents; grapes (248), 1, 5 cents; oranges (250), 9, 27 cents; peaches, canned (253), 1, 4 cents. Total fruits.	3.1	1.5	113	1.3	99

^a See footnote r to Table 1.^b Oysters, raw, 15 cents per dozen; 10 cents per half dozen.

TABLE 6.—*Kinds of food, number of orders, and cost of each kind, and average cost and amounts of protein and energy of dietary study No. 404—Continued.*

SUBJECT D—Continued.

Kinds of food, number of orders, and cost of each kind.	Cost, protein, and energy of daily food.				
	Total.			Digestible protein.	Available energy.
	Cost.	Protein.	Energy.		
<i>Period 2, 3 weeks, February 14 to March 6—Continued.</i>					
Sirup (260), 8, 16 cents; sugar (259), 112, 0. ^a Total sugars, etc	<i>Cents.</i> 0.8	<i>Grams.</i>	<i>Calories.</i> 258	<i>Grams.</i>	<i>Calories.</i> 253
Chocolate (265), 21, \$1.05; coffee (263), 2, 6 cents. Total beverages	5.3	4.0	135	3.9	132
Total food	42.1	65.9	2,820	59.1	2,595
<i>Period 3, 3 weeks, May 8 to May 28.</i>					
Beefsteak (12), 5, 50 cents; pork, ham cake (44), 2, 20 cents. Total meats, etc.....	3.3	12.1	159	11.7	138
Soups (61), 2, 6 cents	.3	.6	9	.6	8
Bass, fried (62), 1, 10 cents; mackerel (64), 4, 40 cents; shrimp salad (75), 1, 15 cents; trout, baked (66), 1, 10 cents. Total fish, etc	3.6	9.2	73	8.9	62
Eggs, scrambled (86), 2, 16 cents	.8	4.1	87	4.0	77
Butter (89), 75, 75 cents; cream (92), 13, ^b 84 cents; milk, glass (95), 1, 2 cents; milk, 4-ounce pitchers (96), 4, 4 cents. Total dairy products.....	7.8	4.8	659	4.7	613
Hominy (102), 10, 30 cents; rice (108), 2, 6 cents; shredded wheat (109), 34, ^c 68 cents. Total breakfast cereals, etc	4.9	6.7	275	5.7	250
Biscuit (127), 1, 1 cent; rolls (133), 38, 38 cents; toast, buttered (136), 12, 36 cents; griddlecakes (146), 5, 20 cents; crackers for soup (154), 2, 2 cents. Total breads, crackers, etc	4.6	16.3	586	13.9	533
Cake (160), 3, 3 cents; doughnuts (166), 1, 1 cent; puddings (177), 1, 4 cents; coffee jelly (187), 4, 16 cents; ice cream (184), 2, 14 cents; sherbet (188), 1, 6 cents. Total desserts, etc.....	2.1	1.8	103	1.5	96
Peas (197), 1, 2 cents; potatoes, baked (201), 5, 10 cents; potatoes, boiled (202), 5, 10 cents; potatoes, griddled (210), 1, 10 cents; potatoes, French fried (209), 10, 50 cents; potatoes, lyonnaise (212), 5, 25 cents; corn (225), 2, 4 cents; radishes (228), 2, 8 cents; tomatoes (233), 1, 2 cents. Total vegetables.....	5.8	4.7	246	3.9	224
Bananas (244), 6, 12 cents; oranges (251), 1, 3 cents; peaches, canned (253), 7, 28 cents; strawberries (256), 3, 26 cents. Total fruits, etc.....	3.3	.7	49	.6	43
Honey (261), 1, 4 cents; sirup (260), 5, 10 cents; sugar, teaspoonfuls (259), 192, 0. ^a Total sugars, etc.....	.7	.....	386	.....	378
Chocolate (265), 19, 95 cents; coffee (263), 19, 57 cents; lemonade (267), 2, 4 cents. Total beverages.....	7.4	4.8	157	4.7	154
Total food	44.6	65.8	2,789	60.2	2,576
Average for three periods	42.7	67.6	2,789	61.5	2,566

^a See footnote *r* to Table 1.^b Includes one order of cream, served with strawberries, for which there was no charge.^c Orders for one-half the usual amount.

In the dietary of this subject the unusually small amounts of protein and energy in the total food eaten per diem, the high comparative cost of the diet, and the small number of combination meals are noticeable. Thus for the three periods the digestible protein averages 61.5 grams and the available energy 2,566 calories, or 67 and 95 per cent, respectively, of amounts called for by the commonly accepted standard for a man of sedentary occupation. Though low in nutritive value, this ration cost 42.7 cents per day.

The protein from animal foods amounted to about 54.5 per cent and the energy to about 38 per cent of the total.

It is easy to suggest changes whereby the value of the ration might have been increased without increasing the cost. The amount spent for meats, beverages, and cereals is about 35 per cent, that for vegetables about 80 per cent, and for fruits about 25 per cent higher than the average for the ten men studied. In the case of cereals this increase was profitable, since they are economical foods at the Randall Hall prices, but, as noted before, meats are an expensive source of nutrients, while beverages and fruits yield very little protein and energy. Thus for an expenditure of about 7.4 cents, or 17 per cent of the total cost of the diet, the fruits and beverages together furnished only about 6.5 per cent of the total digestible protein and about 7 per cent of the total available energy, whereas the same sum expended for breadstuffs would have increased the diet by nearly one-quarter of the total nutrients involved. A further economy could have been brought about by devoting part of the sum expended for meat, especially during period 2, to combination meals and by using cheaper meat foods, such as beef stew, beef potpie, meat croquettes, and hash, in place of rump steak, sausage, ham cakes, and various sorts of fish. In the class of vegetable foods not only was the amount spent 80 per cent higher than the average, but the quantities of protein and energy procured per unit of money were less. A smaller expenditure for vegetables and the selection of baked beans, baked or hashed brown potatoes, and sweet potatoes in place of the more expensive potato salad, French fried and lyonnaise potatoes would have been more economical. In the case of breads the quantities of digestible protein and available energy obtained for 1 cent amounted to but 65 and 70 per cent, respectively, of the average amounts obtained by the ten subjects. The quite general use of toast and griddlecakes in place of the more economical white bread was the probable cause of this condition, which affects the value of the ration very materially, since breadstuffs furnished over 20 per cent of the total nutrients. The quantity of protein furnished by the dairy products per money unit dropped in period 2 to 60 per cent, and in period 3 to a little over 35 per cent of that in period 1, owing to a decrease in the amount of milk used and an increase in the amount of cream.

The weight of Subject D, at the end of the investigation, was 120.5 pounds, showing a gain of 1 pound in about six months. Such a difference might easily have been occasioned by the daily fluctuation in intestinal contents, etc., so we may infer that the weight was practically constant throughout the college year. Examination showed that his general physical condition, which was rather below par at the outset, had not changed. Anthropometric measurements also disclosed no changes.

The standing of Subject D in his studies was creditable. His courses

may be fairly said to provide a moderately hard year's work, yet he passed with an average grade of B.

In general it may be said that this subject, whose diet contained but 67 per cent of the protein and 95 per cent of the energy called for by the standard selected for comparison, did his work well throughout the year, and showed neither loss of weight nor any physical deterioration that could be detected by careful medical examination. The unusually small quantity of protein in the daily ration brings up the question whether he was really in nitrogen equilibrium or whether he was losing nitrogen and replacing it by fatty tissue or water. It would, therefore, have been especially interesting had opportunity offered to determine the outgo of nitrogen in order to test the question.

DIETARY STUDY NO. 405.

Subject E was 26 years old, 5 feet 5.5 inches in height, and weighed 136.3 pounds. Although small of stature, his measurements in other respects were not far from the general run of men of the same age. Examination showed that he was in fair physical condition and fairly well nourished.

He was a senior in the Lawrence Scientific School and carried about seven courses, most of which pertained to engineering. The university work was, perhaps, no more difficult than that of many scientific students in their senior year.

He spent daily $7\frac{3}{4}$ to 8 hours in sleep, $6\frac{1}{2}$ to $9\frac{1}{2}$ hours in college work, and had no outside work. His exercise consisted in walking two or three miles per day.

TABLE 7.—*Kinds of food, number of orders, and cost of each kind, and average cost and amounts of protein and energy of dietary study No. 405.*

SUBJECT E.

[For explanation of numbers in parentheses, see p. 11.]

Kinds of food, number of orders, and cost of each kind.	Cost, protein, and energy of daily food.				
	Total.			Digestible protein.	Available energy.
	Cost.	Protein.	Energy.		
<i>Period 1, 3 weeks, November 30 to December 20.</i>					
Beef hash (20), 3, 21 cents; beefsteak pie (25), 1, 10 cents; lamb, roast (32), 3, 30 cents; venison potpie (30), 1, 10 cents; lamb croquettes (37), 1, 10 cents; turkey and sance (54), 4, 60 cents. Total meats, etc.	<i>Cents.</i> 6.7	<i>Grams.</i> 21.5	<i>Calories.</i> 284	<i>Grams.</i> 20.9	<i>Calories.</i> 247
Chowder (57), 5, 15 cents; purée of peas (58), 3, 9 cents; soup (59), 5, 15 cents. Total soups, etc.....	1.9	3.9	77	3.8	66
Oysters, raw (68), 3, 45 cents; oyster pie (73), 1, 12 cents. Total fish, etc.....	2.7	3.5	50	3.4	43
Eggs, raw (77), 2, 16 cents; omelet (81), 2, 20 cents. Total eggs, etc.....	1.7	3.1	52	3.0	46
Butter (87), 41, 41 cents; milk, bowl (94), 4, ^a 18 cents; milk, glass (95), 49, 98 cents; milk, 4-ounce pitchers (96), 6, 6 cents. Total dairy products.....	7.8	18.9	591	18.3	550

^a Includes two orders of hot milk.

TABLE 7.—*Kinds of food, number of orders, and cost of each kind, and average cost and amounts of protein and energy of dietary study No. 403—Continued.*

SUBJECT E—Continued.

Kinds of food, number of orders, and cost of each kind	Cost, protein, and energy of daily food				
	Total.			Digestible protein.	Available energy
	Cost.	Protein.	Energy.		
<i>Period 1, 3 weeks, November 30 to December 20—Cont'd.</i>					
Prepared cereal (97), 2, 8 cents; rice (106), 2, 8 cents; shredded wheat (109), 2, 8 cents. Total breakfast cereals	<i>Cents.</i> 1.1	<i>Grams.</i> 1.0	<i>Calories.</i> 65	<i>Grams.</i> 0.9	<i>Calories.</i> 40
Bread, white (113), 63, 63 cents; bread, Graham (116), 1, 1 cent; bread, corn (119), 12, 12 cents; bismit (125), 1, 1 cent; gems, Graham (130), 5, 5 cents; rolls (131), 12, 12 cents; toast, creamed (138), 1, 7 cents. Total breads, crackers, etc	4.8	23.8	765	20.2	696
Cake, cream (158), 1, 4 cents; pie, apple (172), 4, 20 cents; pudding, tapioca (175), 3, 15 cents. Total desserts	1.9	2.7	160	2.3	149
Beans, baked (189), 1, 4 cents; sweet potatoes (216), 6, 12 cents; celery (222), 3, 15 cents; onions, boiled (227), 6, 18 cents. Total vegetables	2.3	2.8	140	2.5	127
Apples (240), 16, 32 cents; oranges (252), 3, 9 cents; sauce, cranberry (258), 2, 8 cents. Total fruits	2.3	.5	66	.4	58
Sugar (269), 98, 0¢			166		163
Combination breakfasts (268), 8, 80 cents; lunches (271), 4, 40 cents; dinners (274), 6, 72 cents. Total combination meals	9.2	24.2	664	22.3	611
Total food	42.4	105.9	3,080	97.8	2,815
<i>Period 2, 3 weeks, February 14 to March 6.</i>					
Veal, roast (with dressing) (28), 1, 10 cents; dressing (with veal) (29), 1, 0¢; lamb, roast (33), 4, 40 cents; turkey, roast (56), 2, 30 cents. Total meats, etc	3.8	12.2	123	11.8	107
Chowder (57), 2, 6 cents; purée of peas (58), 1, 3 cents; soup (60), 3, 9 cents. Total soups, etc	.9	1.5	29	1.5	25
Lobster (67), 2, 30 cents; oyster stew (71), 1, 10 cents; fishballs (76), 2, 10 cents. Total fish, etc	3.3	4.0	47	3.9	40
Eggs (with toast) (77), 1, 8 cents; egg omelet (82), 9, 90 cents. Total eggs, etc	4.7	10.5	203	10.2	181
Butter (88), 24, 24 cents; milk, glass (95), 71, \$1.42; milk, 4-ounce pitchers (96), 2, 2 cents. Total dairy products	8.0	22.7	539	22.0	567
Prepared cereal (98), 1, 4 cents; rice (107), 1, 3 cents. Total breakfast cereals	.3	.5	18	.4	16
Bread, white (114), 37, 37 cents; bread, Graham (117), 4, 4 cents; bread, corn (120), 11, 11 cents; bismit (126), 1, 1 cent; gems, Graham (128), 4, 4 cents; rolls (132), 14, 14 cents; toast (134), 2, 4 cents; toast, creamed (138), 1, 7 cents; toast (with eggs) (140), 1, 2 cents; macaroni (157), 1, 7 cents. Total breads, crackers, etc	4.3	18.8	609	16.0	554
Puddings (176), 2, 9 cents	.4	.7	28	.6	26
Beans, baked (190), 2, 8 cents; sweet potatoes (217), 10, 20 cents; onions, boiled (227), 6, 18 cents. Total vegetables	2.2	4.7	228	3.9	207
Apples (240), 19, 38 cents; bananas (243), 6, 12 cents; grapes (248), 2, 10 cents; oranges (250), 12, 36 cents; sauce, cranberry (258), 1, 4 cents. Total fruits	4.8	1.7	149	1.4	131
Sugar, teaspoonfuls (269), 16, 0¢			27		27
Combination breakfasts (269), 6, 60 cents; lunches (272), 9, 90 cents; dinners (275), 8, 96 cents. Total combination meals	11.7	32.3	921	29.7	847
Total food	44.4	109.6	2,984	101.4	2,718
<i>Period 3, 3 weeks, May 8 to May 28.</i>					
Turkey, roast, and dressing (56), 6, 90 cents	4.3	17.2	158	16.7	137
Purée of peas (58), 1, 3 cents; soup (61), 2, 6 cents. Total soups, etc	.4	1.0	17	1.0	15
Shrimp salad (75), 1, 15 cents	.7	2.2	13	2.1	11
Eggs, dropped (77), 2, 6 cents; egg omelet (83), 4, 32 cents. Total eggs, etc	1.8	4.3	81	4.2	72
Butter (89), 32, 32 cents; cream (with strawberries) (93), 3, 0¢; milk, glass (95), 91, \$1.82; milk, 4-ounce pitchers (96), 5, 5 cents. Total dairy products	10.4	29.7	807	28.8	751

^aSee footnote *r* to Table 1. ^bOrders for one-half the usual amount.

TABLE 7.—*Kinds of food, number of orders, and cost of each kind, and average cost and amounts of protein and energy of dietary study No. 405—Continued.*

SUBJECT E—Continued.

Kinds of food, number of orders, and cost of each kind.	Cost, protein, and energy of daily food.				
	Total.			Digestible protein.	Available energy.
	Cost.	Protein.	Energy.		
<i>Period 3, 3 weeks, May 8 to May 28—Continued.</i>					
Oatmeal (105), 3, 9 cents; rice (108), 1, 3 cents; shredded-wheat (109), 1, ^a 2 cents; wheat (111), 1, 3 cents. Total breakfast cereals.....	<i>Cents.</i> 0.8	<i>Grams.</i> 1.5	<i>Calories.</i> 48	<i>Grams.</i> 1.3	<i>Calories.</i> 44
Bread, white (115), 45, 45 cents; bread, corn (121), 5, 5 cents; gems, Graham (129) 9, 9 cents; rolls (133), 18, 18 cents; toast (134), 1, 2 cents; toast (with asparagus) (141), 3, 0 ^b ; macaroni (156), 1, 6 cents. Total breads, etc.....	4.0	21.0	675	17.9	614
Cake (160), 3, 3 cents; pie (174), 1, 4 cents; pudding (177), 3, 12 cents; tarts (181), 1, 2 cents; ice cream (184), 1, 7 cents. Total desserts.....	1.3	2.0	113	1.7	105
Peas (197), 2, 4 cents; potatoes, mashed (205), 4, 8 cents; asparagus (with toast) (218), 3, 24 cents; corn (225), 1, 2 cents; onions (227), 5, 15 cents; spinach (229), 3, 6 cents; succotash (231), 4, 8 cents; tomatoes (233), 2, 4 cents. Total vegetables.....	3.4	2.6	83	2.2	76
Apples (240), 6, 12 cents; oranges (251), 7, 21 cents; prunes, stewed (255), 3, 12 cents; strawberries (256), 3, 25 cents; preserves (257), 16, 64 cents; sauces (258), 3, 12 cents. Total fruits, etc.....	7.0	1.2	205	1.0	180
Sugar, teaspoonfuls (259), 26, 0 ^b			44		43
Lemonade (267), 2, 4 cents.....	.2		9		9
Combination breakfasts (270), 5, 50 cents; lunches (273), 12, \$1.20; dinners (276), 1, 12 cents. Total combination meals.....	8.7	16.6	592	15.3	545
Total food.....	43.0	99.3	2,845	92.2	2,602
Average for three periods.....	43.3	104.9	2,969	97.1	2,712

^a Order for one-half the usual amount.^b See footnote *r* to Table 1.

The amounts of digestible protein and available energy per diem for all three periods averaged 97.1 grams protein and 2,712 calories, or practically the quantities called for by the commonly accepted standard for a man of sedentary occupation. In this study 67 per cent of the digestible protein came from animal sources.

The average cost of the ration was 43.3 cents per day. Of this about 10 per cent was expended for fruits, yielding only 1 per cent of the total protein and 4.5 per cent of the total energy, whereas the sum expended for breads, also 10 per cent of the total, supplied about 20 per cent of the total protein and energy. It is not to be inferred that fruit should not be used; the purpose of the above comparison is simply to emphasize the economy of minimizing as far as possible the expenditure for foods that contain little nourishment per money unit without destroying the palatability of the ration. On foods relatively rich in protein (meats, eggs, and dairy products) Subject E spent from 30 to 60 per cent more than the average of the 10 men studied, which accounts for the relatively high proportion of protein and energy derived from animal foods. The expenditure for vegetable foods is of course correspondingly low; thus his expenditure for cereals was only 20 per cent, that for desserts 50 per cent, breads 70 per cent

and for vegetables 80 per cent. of the average amounts spent by the ten subjects for such materials. It is to be noticed that he used considerable sugar (for which no charge is made) and got along practically without beverages (tea, coffee, and cocoa), thereby effecting a considerable saving. As regards dairy products, the quantity of protein bought for 1 cent is about 35 per cent higher than the average for the ten men, and that of energy about equal to the average.

At the end of the investigation Subject E had gained 3.7 pounds in weight and showed a corresponding slight increase in his anthropometric measurements. No change in his general physical condition was noted.

In the examinations at the end of the academic year he passed in all his studies with an average grade a little below B, a very creditable performance considering the fact that he carried seven courses.

In general, it may be said that Subject E accomplished a satisfactory year's work, chiefly intellectual in nature, on a diet which averaged for the three test periods almost exactly the amounts of protein and energy required by a commonly accepted standard for a man of sedentary occupation, and maintained his general health and physical condition.

DIETARY STUDY NO. 406.

Subject F was 25 years old, 5 feet 3.8 inches in height, and weighed 120.2 pounds. He was a small man but tolerably well proportioned. Like the majority of the men included in this investigation he was in fair physical condition. His daily programme differs from most of the others in that he spent rather less time on college work and slept longer, devoting 7 to 7½ hours daily to college duties and 8 to 8½ hours to sleep. He did no outside work. During the fall and winter periods he walked or took gymnasium exercises 30 minutes to 1 hour daily. During the three weeks covered by the spring period he walked or played handball three-fourths to 1½ hours per day for seven days.

Subject F was a second-year student in the graduate school, and carried the equivalent of four full courses about equally divided between the classical languages and philology.

TABLE 8.—*Kinds of food, number of orders, and cost of each kind, and average cost and amounts of protein and energy of dietary study No. 406.*

SUBJECT F.

[For explanation of numbers in parentheses, see p. 11.]

Kinds of food, number of orders, and cost of each kind.	Cost, protein, and energy of daily food.				
	Total.			Digestible protein.	Available energy.
	Cost.	Protein.	Energy.		
<i>Period 1, 3 weeks, November 30 to December 20.</i>					
Beef croquettes (18), 2, 20 cents; beef hash (20), 1, 7 cents; roast turkey and sauce (54), 2, 30 cents. Total meats.....	<i>Cents.</i> 2.7	<i>Grams.</i> 13.1	<i>Calories.</i> 128	<i>Grams.</i> 12.7	<i>Calories.</i> 111
Purée of peas (58), 1, 3 cents; soup (59), 1, 3 cents. Total soups, etc.....	.3	.6	13	.6	11
Egg omelet (81), 2, 20 cents.....	.9	1.9	36	1.8	32
Butter (87), 57, 57 cents; cheese, sage (91), 1, 1 cent; milk, glass (95), 1, 2 cents; milk, bowl (94), 1, 4 cents; milk, 4-ounce pitchers (96), 1, 1 cent. Total dairy products.....	3.1	1.6	285	1.6	265
Rice (106), 1, 4 cents.....	2	.2	8	.2	7
Bread, white (113), 60, 60 cents; bread, Graham (116), 70, 70 cents; crackers for soup (152), 2, 2 cents; macaroni (155), 1, 7 cents. Total bread, crackers, etc.....	6.6	37.9	1,208	32.2	1,099
Cookies (161), 4, 4 cents; gingerbread (168), 4, 4 cents; cake (158), 13, 13 cents; pie (172), 1, 5 cents; tarts (181), 2, 4 cents; puddings (175), 2, 7 cents. Total desserts, etc.....	1.8	4.1	250	3.5	232
Beans, baked (189), 3, 12 cents; sweet potatoes (216), 4, 8 cents; turnips (235), 1, 3 cents. Total vegetables.....	1.1	3.6	125	3.0	114
Bananas (245), 3, 6 cents; preserves, pineapple (257), 1, 4 cents. Total fruits, etc.....	.5	.2	23	.2	20
Sugar, teaspoonfuls (259), 132, 0 ^a			223		219
Coffee (263), 21, 63 cents; cocoa (262), 27, 81 cents. Total beverages.....	6.9	4.1	105	4.0	103
Combination lunches (271), 8, 80 cents; dinners (274), 10, \$1.20. Total combination meals.....	9.5	25.3	712	23.3	655
Total food.....	33.6	92.6	3,116	83.1	2,868
<i>Period 2, 3 weeks, February 19 to March 11.</i>					
Beefsteak (11), 1, 10 cents; pork, fried ham (45), 1, 10 cents. Total meats, etc.....	1.0	2.6	33	2.5	29
Purée of peas (58), 1, 3 cents.....	.1	.4	9	.4	8
Butter (88), 15, 15 cents; cheese (90), 3, 3 cents; milk, glass (95), 17, 34 cents; milk, bowl (94), 4, 16 cents. Total dairy products.....	3.2	8.5	247	8.2	230
Bread, white (114), 32, 32 cents; bread, Graham (117), 32, 32 cents; bread, corn (120), 15, 15 cents; biscuits (126), 3, 3 cents; rolls (132), 14, 14 cents; crackers (153), 1, 1 cent; crackers, Graham (149), 1, 3 cents. Total bread, crackers, etc.....	4.8	24.9	823	21.2	749
Cake (159), 25, 25 cents; cookies (162), 11, 11 cents; tarts, damson (181), 4, 8 cents. Total desserts, etc.....	2.1	5.1	322	4.3	299
Potatoes, baked (200), 1, 2 cents; sweet potatoes (217), 2, 4 cents; onions, raw (226), 1, 3 cents. Total vegetables.....	.4	.7	46	.6	42
Figs, dried (249), 2, 8 cents.....	.4	.3	27	.3	24
Sugar, teaspoonfuls (259), 144, 0 ^a			244		239
Cereal coffee (264), 1, 3 cents; cocoa (262), 29, 87 cents; coffee (263), 8, 24 cents. Total beverages.....	5.4	2.8	79	2.7	77
Combination breakfasts (269), 17, \$1.70; lunches (272), 12, \$1.20; dinners (275), 7, 84 cents. Total combination meals.....	17.8	48.5	1,444	44.6	1,328
Total food.....	35.2	93.8	3,274	84.8	3,025
<i>Period 3, 3 weeks, May 8 to May 28.</i>					
Beef, Hamburg steak (13), 1, 10 cents; pork, bacon (with eggs) (41), 1, 4 cents. Total meats, etc.....	.7	2.1	26	2.0	23
Eggs (with bacon), (80), 1, 6 cents; egg omelet (83), 1, 8 cents. Total eggs, etc.....	.7	1.4	28	1.4	25
Butter (89), 19, 19 cents; cream (for strawberries) (93), 1, 0 ^a ; milk, bowl (94), 2, 8 cents; milk, glass (95), 12, 24 cents; milk, 4-ounce pitchers (96), 1, 1 cent. Total dairy products.....	2.5	5.7	208	5.5	193

^a See footnote *r* to Table 1.

TABLE 8.—*Kinds of food, number of orders, and cost of each kind, and average cost and amounts of protein and energy of dietary study No. 406—Continued.*

SUBJECT F—Continued.

Kinds of food, number of orders, and cost of each kind	Cost, protein, and energy of daily food.				
	Total.			Digestible protein.	Available energy.
	Cost.	Protein.	Energy.		
<i>Period 3, 3 weeks, May 8 to May 18—Continued.</i>					
Bread, white (115), 49, 49 cents; bread, Graham (118), 30, 30 cents; bread, corn (121), 6, 6 cents; rolls (153), 1, 1 cent; scones (142), 3, 3 cents; griddle cakes (146), 1, 4 cents. Total bread, crackers, etc.	<i>Cents.</i> 1.7	<i>Grams.</i> 27.1	<i>Calories.</i> 867	<i>Grams.</i> 23.0	<i>Calories.</i> 789
Cakes (160), 31, 37 cents; cookies (164), 3, 5 cents; pies (174), 2, 8 cents; pudding (177), 4, 16 cents; short cake (strawberries only) (179), 2, 14 cents; short cake (crust only) (180), 2, 0 9; tarts, raspberry (181), 2, 4 cents; ice cream (184), 2, 14 cents; sherbet (188), 1, 6 cents. Total desserts, etc.	5.0	8.2	199	7.0	464
Potatoes, lyonnaise (212), 1, 2 cents.	.1	.2	12	.2	11
Bananas (244), 6, 12 cents; strawberries (with cream) (264), 1, 7 cents; preserves, raspberry (257), 1, 4 cents; preserves, strawberry (257), 3, 12 cents. Total fruits.	1.7	.4	59	.3	52
Honey (261), 1, 4 cents; sirup (260), 1, 2 cents; sugar, teaspoonfuls (259), 100, 0 9. Total sugars, etc.	3	...	191	...	187
Cereal coffee (264), 24, 72 cents; cocoa (262), 13, 39 cents; coffee (263), 1, 3 cents; lemonade (267), 2, 4 cents. Total beverages.	3.6	1.7	60	1.6	59
Combination breakfasts (270), 6, 60 cents; lunches (273), 16, \$1.50; dinners (276), 5, 60 cents. Total combination meals.	12.8	24.8	844	22.8	776
Total food	34.1	71.6	2,794	63.8	2,579
Average for three periods	34.7	86.0	3,061	77.2	2,824

^a See footnote *r* to Table 1.

It will be seen that the above dietary provided a simple and tolerably economical ration, with 45 per cent of the total digestible protein and 29 per cent of the available energy furnished by animal foods. Ordinarily in student dietsaries studied in the United States, the protein from animal sources, as before stated, has been found to amount to 60 per cent and the energy from the same source to 43 per cent of the total. The most noticeable item of expense was for combination meals, which amounted to nearly 40 per cent of the cost of the day's food, or more than twice the average percentage expenditure for the ten men included in this investigation. Since combination meals were relatively cheap, this was a wise selection. The liberal use of combination meals and the fact that Subject F secured (owing to the almost exclusive use of white and Graham bread), for 1 cent spent on breadstuffs, about 19 per cent more protein and 15 per cent more energy than the average computed for the ten men, are the chief reasons for the economy of the ration. He ate no cereal breakfast foods, and only about 25 per cent as much meat and vegetables as the average. On the other hand, he was fully up to the average on breads, while on desserts he was 25 per cent, and on beverages 200 per cent above the average. The sums expended for the last two articles are the only ones which could not be defended on the

ground of economy under the circumstances. It does not necessarily follow that Subject F's ration would have been better adapted to his needs if he had used the money spent on beverages and desserts for the purchase of cheaper foods, because it might well be that such a change would have lessened the very essential element of palatability. It should be borne in mind that all the alterations suggested in favor of greater economy (i. e., increased amounts of nutrients for the same cost) in this case and the others are based on the assumption that within wide limits one food is as acceptable as another to a hungry man, and that the men studied were trying to nourish themselves satisfactorily on a small sum.

As has been noted with a number of the men, Subject F's ration was noticeably lower for period 3 than for the other periods. Thus in periods 1 and 2 the average was 83.9 grams of digestible protein and 2,946 calories of available energy, but in period 3 it was only 63.8 grams and 2,577 calories. This falling off was due chiefly to the decline in the nutritive value of the combination meals (see p. 22) and the increased use of fruits and desserts without a proportionate increase in the total cost of the ration. For the three periods the ration averaged 77.2 grams of digestible protein and 2,824 calories available energy per diem, or 84 and 104 per cent of the amounts called for by the commonly accepted standard for a man of sedentary occupation. We have here another instance of very low protein consumption coupled with a rather plentiful energy supply. So far as we may judge from physical examination and measurements at the end of the test period, Subject F held his own with the demands, both intellectual and physical, of his college life. In fact he showed the slight gain in weight (in this case 1.8 pounds) and in anthropometric measurements that was noticed with the majority of the men, which seems to indicate, at least in the case of a man whose normal body growth was completed, that there was no physical deterioration. His scholarship was very high, if we may judge from the fact that he passed his examinations with the grade of A, the highest mark that is given at Harvard University.

DIETARY STUDY NO. 407.

Subject G was 22 years old, 5 feet 8.5 inches in height, and weighed 143.3 pounds, and, unlike all the subjects before considered, showed a remarkably close approximation to the average for his age both in stature and in physical measurements, being classed as fairly well developed and nourished. He was a senior in the college and carried five courses, none of which was generally considered to be very difficult. Of all the men, his period for sleep was the shortest, being but $6\frac{1}{2}$ to $6\frac{3}{4}$ hours. He spent 9 to $9\frac{3}{4}$ hours daily on his college work, but had no outside duties to perform. It was only during

period 1 that he took any physical exercise, and then it was limited to walking for 1 to 2 hours or skating for 45 minutes per day on 2 or 3 days.

TABLE 9. — *Kinds of food, number of orders, and cost of each kind, and average cost and amounts of protein and energy of dietary study No. 407.*

SUBJECT G.

[For explanation of numbers in parentheses see p. 11.]

Kinds of food, number of orders, and cost of each kind.	Cost, protein, and energy of daily food.				
	Total.			Digestible protein.	Available energy.
	Cost.	Protein.	Energy.		
<i>Period 1, 3 weeks, November 30 to December 20.</i>					
Beefsteak (10), 9, 90 cents; beef, rump steak (14), 5, \$1; beef, Hamburg steak (13), 1, 10 cents; beef, roast (6), 4, 40 cents; beef, frizzled (with eggs) (23), 1, 10 cents; beef, potpie (25), 1, 10 cents; veal cutlets (27), 1, 15 cents; mutton chops (31) 1, 25 cents; lamb, roast, cold (35), 1, 10 cents; pork, bacon (with eggs) (39), 3, 12 cents; pork cutlets (with fried apples) (43), 2, 30 cents; turkey, roast (with sauce) (54), 1, 15 cents. Total meats, etc.....	<i>Cents.</i> 17.5	<i>Grams.</i> 42.5	<i>Calories.</i> 597	<i>Grams.</i> 41.2	<i>Calories.</i> 519
Chowder (57), 3, 9 cents; soup (59), 6, 18 cents; purée of peas (58), 2, 6 cents. Total soups, etc.....	1.5	3.1	60	3.0	52
Oysters, raw, 1/2 dozen (68), 1, 10 ^a cents; oyster stew, ordinary (70), 2, 20 cents; oyster stew, special (72), 1, 15 cents; smelts, fried (65), 1, 15 ^b cents. Total fish, etc.....	2.8	3.3	35	3.2	90
Eggs, boiled (77), 2, 16 cents; eggs, fried (78), 7, 56 cents; eggs (with bacon) (78), 3, 24 cents; omelet (81), 1, 10 cents. Total eggs.....	5.0	8.0	144	7.8	128
Butter (87), 57, 57 cents; milk, glass (95), 10, 20 cents; milk, 4-ounce pitchers (96), 21, 21 cents. Total dairy products.....	4.7	7.0	355	6.8	330
Oatmeal (103), 21, 84 cents.....	4.0	7.6	212	6.5	193
Bread, white (113), 15, 16 cents; bread, corn (119) 1, 1 cent; biscuit (125), 4, 4 cents; rolls (131), 67, 67 cents; toast, buttered (135), 8, 24 cents; buckwheat cakes (143), 3, 15 cents; griddlecakes (147), 6, 30 cents; crackers for soup (152), 11, 11 cents. Total bread, crackers, etc.....	8.0	29.8	1,039	25.3	945
Doughnuts (164), 2, 2 cents; gingerbread (168), 9, 9 cents; cake (158), 2, 5 cents; ice cream (182), 1, 7 cents; pies (172), 11, 55 cents; coffee jelly (185), 9, 36 cents; puddings (175), 9, 45 cents. Total desserts, etc.....	7.6	10.2	587	8.7	546
Peas (198), 1, 3 cents; potatoes, baked (199), 5, 10 cents; potatoes, fried (207), 2, 4 cents; potatoes, mashed (203), 5, 10 cents; tomatoes, stewed (234), 3, 9 cents. Total vegetables.....	1.7	2.4	109	2.0	99
Grapes (247), 1, 3 cents; apples, fried (with pork cutlets) (242), 2, 0c. Total fruits.....	.1	.....	13	.....	11
Sirup (260), 9, 18 cents; sugar, teaspoonfuls (259), 180, 0c. Total sugars, etc.....	.9	.....	394	.....	386
Cocoa (262), 5, 15 cents; coffee (263), 23, 69 cents; tea (263), 23, 69 cents. Total beverages.....	7.3	3.7	82	3.6	80
Total food.....	61.2	117.6	3,627	108.1	3,319
<i>Period 2, 3 weeks, February 14 to March 6.</i>					
Beef, roast (7), 4, 40 cents; beefsteak (11), 1, 10 cents; beef, rump steak (14), 2, 40 cents; beef, tenderloin (15), 1, 50 cents; beef, Hamburg steak (13), 1, 10 cents; beef, corned (3), 2, 16 cents; pork cutlets (43), 1, 15 cents; pork, bacon (with eggs) (40), 3, 12 cents; pork, ham (with eggs) (48), 1, 12 cents; veal, roast (with gravy) (28), 1, 10 cents; gravy (with roast veal) (29), 1, 0c; turkey, roast (55), 3, 45 cents; veal cutlets (27), 3, 45 cents; lamb, roast (33), 1, 10 cents. Total meats, etc.....	15.0	32.6	485	31.6	422
Chowder (57), 3, 9 cents; purée of peas (58), 1, 3 cents; soup (60), 8, 24 cents. Total soups, etc.....	1.7	2.7	48	2.6	41

^aOysters, raw, 15 cents per dozen; 10 cents per half dozen.
^bExtra charge of 5 cents for Tartare sauce.
^cSee footnote *r* to Table 1.

TABLE 9.—*Kinds of food, number of orders, and cost of each kind, and average cost and amounts of protein and energy of dietary study No. 407—Continued.*

SUBJECT G—Continued.

Kinds of food, number of orders, and cost of each kind.	Cost, protein, and energy of daily food.				
	Total.			Digestible protein.	Available energy.
	Cost.	Protein.	Energy.		
<i>Period 2, 3 weeks, February 14 to March 6—Continued.</i>					
Cod, fried (62), 2, 22 cents; halibut, fried (63), 2, ^a 25 cents; oyster stew (71), 1, 10 cents; oyster stew, extra (72), 2, 30 cents. Total fish, etc.....	<i>Cents.</i> 4.1	<i>Grams.</i> 9.9	<i>Calories.</i> 109	<i>Grams.</i> 9.6	<i>Calories.</i> 93
Eggs, fried (79), 8, 64 cents; eggs, scrambled (85), 2, 20 cents; eggs, fried (with bacon) (79), 3, 24 cents; eggs, fried, (with ham), (79), 1, 8 cents. Total eggs, etc.....	5.5	9.9	195	9.6	174
Butter (88), 56, 56 cents; milk, glass (95) 24, 48 cents; milk, 4-ounce, pitchers (96), 25, 25 cents. Total dairy products.....	6.1	12.0	508	11.6	472
Oatmeal (104), 21, 63 cents; rice (107) 4, 12 cents. Total breakfast cereals, etc.....	3.6	5.7	172	4.8	157
Bread, white (114), 14, 14 cents; bread, corn (120), 21, 21 cents; biscuit (126), 1, 1 cent; rolls (132), 52, 52 cents; toast, buttered (135), 14, 42 cents; crackers (153), 11, 11 cents; buckwheat cakes (144), 2, 10 cents; griddlecakes (145), 7, 35 cents. Total breads, crackers, etc.....	8.9	30.7	1,092	26.1	994
Cake (159), 3, 6 cents; gingerbread (169), 2, 2 cents; pie (173), 7, 35 cents; pudding (176), 2, 8 cents; coffee jelly (186), 14, 56 cents; ice cream (183), 1, 7 cents. Total desserts, etc.....	5.4	5.8	315	4.9	293
Peas (196), 5, 15 cents; potatoes, baked (200), 4, 8 cents; potatoes, mashed (204), 8, 16 cents; sweet potatoes (217), 1, 2 cents; beets, pickled (219), 1, 3 cents; tomatoes, stewed (232), 2, ^a 8 cents. Total vegetables, etc.....	2.4	3.3	127	2.7	116
Bananas (243), 37, 74 cents; fried apples (with pork cutlets) (242), 1, 0; ^b oranges (250), 21, 63 cents. Total fruits, etc.....	6.5	3.6	269	3.1	237
Sirup (260), 9, 18 cents; sugar (259), 177, 0. ^b Total sugars, etc.....	.9	-----	388	-----	380
Cocoa (262), 2, 6 cents; coffee (263), 27, 81 cents; ginger ale (266), 1, 5 cents; tea (263), 17, 51 cents. Total beverages, etc.....	6.8	3.3	76	3.2	75
Combination lunch (272), 1, 10 cents.....	.5	1.5	47	1.4	43
Total food.....	67.4	121.0	3,831	111.2	3,497
<i>Period 3, 3 weeks, May 3 to May 23.</i>					
Beef, braised (2), 1, 10 cents; beef, corned (4), 2, 16 cents; beef, roast (8), 5, 50 cents; beefsteak (12), 4, 40 cents; beef, rump steak (14), 3, 60 cents; pork, bacon (with eggs) (41), 1, 4 cents; pork cutlets (43), 2, 30 cents; pork, ham (with eggs) (48), 2, 24 cents; turkey, roast and dressing (56), 1, 15 cents. Total meats, etc.....	11.9	33.1	474	32.1	412
Chowder (57), 3, 9 cents; soup (61), 6, 18 cents. Total soups, etc.....	1.3	2.5	45	2.4	39
Mackerel, broiled (64), 2, 20 cents.....	1.0	3.0	25	2.9	21
Eggs, fried (80), 18, ^c 54 cents; eggs, scrambled (86), 7, 56 cents; eggs (with bacon) (80), 1, 6 cents; eggs (with ham) (80), 2, 12 cents. Total eggs, etc.....	6.1	20.4	423	19.8	376
Butter (89), 52, 52 cents; cream (92), 2, 4 cents; cream (with strawberries) (93), 16, 0; ^b milk, bowl (94), 2, 8 cents; milk, glass (95), 49, 98 cents; milk, 4-ounce pitchers (96), 6, 6 cents. Total dairy products.....	8.1	18.8	717	18.2	667
Oatmeal (105), 2, 6 cents; rice (108), 1, 3 cents; shredded wheat (109), 6, ^c 12 cents. Total breakfast cereals, etc.....	1.0	1.7	58	1.5	53
Bread, white (115), 18, 18 cents; bread, corn (121), 40, 40 cents; rolls (133), 30, 30 cents; toast, buttered (136), 15, 45 cents; griddlecakes (146), 10, 40 cents; crackers (154), 2, 2 cents. Total bread, crackers, etc.....	8.3	30.3	1,052	25.8	957
Cake (160), 6, 9 cents; cookies (163), 2, 2 cents; ice cream (184), 8, 64 ^d cents; coffee jelly (187), 8, 32 cents; sherbet (188), 1, 6 cents. Total desserts.....	5.4	3.6	213	3.1	198

^a Includes one special order, with extra charge.
^b See footnote *r* to Table 1.
^c Orders for one-half the usual amount.
^d Includes some kinds of ice cream the price of which was higher than that in Table 1.

TABLE 9.—*Kinds of food, number of orders, and cost of each kind, and average cost and amounts of protein and energy of dietary study No. 307—Continued.*

SUBJECT G—Continued.

Kinds of food, number of orders, and cost of each kind.	Cost, protein, and energy of daily food.				
	Total.			Digestible protein.	Available energy.
	Cost.	Protein.	Energy.		
<i>Period 3, 3 weeks, May 8 to May 28—Continued.</i>					
Peas (197), 5, 10 cents; potatoes, baked (201), 3, 6 cents; potatoes, mashed (205), 6, 12 cents; potatoes, fried (208), 1, 2 cents; potatoes, lyonnaise (212), 3, 6 cents; beets, pickled (219), 1, 3 cents; onions, raw (225), 2, 6 cents; pickles (250), 3, 3 cents; tomatoes (257), 1, 2 cents. Total vegetables, ...	<i>Grams.</i> 2.4	<i>Grams.</i> 3.3	<i>Calories.</i> 148	<i>Grams.</i> 2.7	<i>Calories.</i> 126
Apples, fried (with pork cutlets) (212), 2, 0 <i>a</i> bananas (244), 13, 26 cents; oranges (251), 8, 21 cents; strawberries (256), 16, 81 <i>ao</i> . Total fruits, etc., ...	8.9	2.3	141	2.0	121
Stap (201), 10, 20 cents; sugar (200), 55, 0 <i>a</i> . Total sugars, etc., ...	1.0	.....	192	.....	188
Coffee (263), 5, 15 cents; tea (265), 16, 48 cents. Total beverages	3.0	1.5	31	1.5	30
Total food	58.4	120.5	3,509	112.0	3,191
Average of the three periods	62.3	119.7	3,656	110.1	3,326

a See footnote *g* to Table 1.

The diet of Subject G is especially interesting, as this is the only instance among the ten men studied in which the cost of board was apparently of little moment. An increased variety and quantity of food are noticeable. Thus, for the three periods the daily ration cost on an average 62.3 cents and contained 110.4 grams of digestible protein and 3,336 calories of available energy, quantities which approach closely to the standard for men with moderately active muscular work, i. e., 115 grams of digestible protein and 3,400 calories of available energy (see Table 14, p. 54). The quantity of protein furnished by animal foods (62.5 per cent of the total amount mentioned above) was higher than the average for the ten men studied. The fact that no combination meals were used is noticeable, and explains the liberal use of many of the other food articles, such as meats, eggs, soups, and desserts. The nutrients in the ration might have been increased without altering the cost by spending less on desserts, beverages, and fruits, of which about 25 per cent more than the average were consumed, and purchasing proportionately more of the cheaper foods, but as economy seems to have been no object there is really little reason to suggest possible changes. The effect of the selection of a variety of dishes within any given food class in lowering the economy of that class is well illustrated in this dietary.

For example, every cent's worth of meats, fish, and eggs procured supplied only about 80 per cent of the protein and 85 per cent of the energy obtained on an average with less variety by the ten men studied. For breads the figures are 75 and 80 per cent, respectively, and for vegetables 63 and 60 per cent, respectively. A glance at the table shows the relatively great variety in the above classes of food.

At the end of the investigation the subject had gained 6.2 pounds in weight and showed a corresponding slight increase in anthropometric measurements. No change in his general physical condition could be noted. He passed his examinations creditably with a grade between B and C.

In this case there can be little doubt that the supply of nutrients was actually sufficient to meet the subject's demands, inasmuch as he gained in weight and showed no sign of physical deterioration. The ration eaten by Subject G, although very liberal in comparison with that of the other men included in this investigation, should not be regarded as excessively large, and the average student who boarded at Randall Hall and was not forced to economize would probably spend fully as much on his food and secure as much protein and energy as did this subject.

DIETARY STUDY NO. 408.

Subject H was 27 years old, 5 feet 10.5 inches in height, and weighed 128.3 pounds. For one of his height he was very slight, but examination showed that he was in fair physical condition and fairly well nourished.

He was a senior in the college and carried five courses, none of which was commonly regarded as especially difficult. He slept about 8 hours and devoted 7 to 8¼ hours daily to his studies. For exercise he walked or rode a bicycle 30 minutes to 1 hour per day for seven days during period 1. In the winter period (period 2) he walked or exercised in the gymnasium 1 hour daily for 10 days, and in period 3 he rode a bicycle 30 minutes to 2 hours daily on 6 days. In addition to college work he served as a waiter at Randall Hall for ¾ to 1½ hours daily for 10 to 13 days during each period. His time was quite fully occupied, but his physical work was not of a very arduous nature.

TABLE 10.—*Kinds of food, number of orders, and cost of each kind, and average cost and amounts of protein and energy of dietary study No. 408.*

SUBJECT H.

[For explanation of numbers in parentheses, see p. 11.]

Kinds of food, number of orders, and cost of each kind.	Cost, protein, and energy of daily food.				
	Total.			Digestible protein.	Available energy.
	Cost.	Protein.	Energy.		
<i>Period 1, 3 weeks, November 30 to December 20.</i>					
Beefsteak (10), 3, 30 cents; beef, roast (6), 3, 30 cents; beef croquettes (18), 1, 10 cents; lamb, roast, with sauce (32), 1, 10 cents; pork, sausage (50), 1, 8 cents; turkey, roast (with dressing) (54), 1, 15 cents.	<i>Cents.</i>	<i>Grams.</i>	<i>Calories.</i>	<i>Grams.</i>	<i>Calories.</i>
Total meats, etc.....	4.9	15.0	178	14.6	155
Soup (59), 15, 45 cents.....	2.1	3.9	61	3.8	52
Whitefish, baked (66), 1, 10 cents.....	.5	1.5	11	1.5	9
Egg omelet (81), 2, 20 cents.....	.9	1.9	36	1.8	32

TABLE 10.—*Kinds of food, number of orders, and cost of each kind, and average cost and amounts of protein and energy of dietary study No. 408—Continued.*

SUBJECT II—Continued.

Kinds of food, number of orders, and cost of each kind.	Cost, protein, and energy of daily food.				
	Total.			Digestible protein	Available energy.
	Cost.	Protein.	Energy.		
<i>Period 1, 3 weeks, November 30 to December 20—Cont'd.</i>					
Butter (87), 28, 28 cents; milk, bowl (hot), (94), 3, 15 cents; milk, glass (95), 3, 6 cents; milk, 4-ounce pitchers (96), 38, 38 cents. Total dairy products.....	<i>Cents.</i> 4.1	<i>Grams.</i> 9.2	<i>Calories.</i> 324	<i>Grams.</i> 8.9	<i>Calories.</i> 301
Prepared cereal (97), 8, 32 cents; oatmeal (103), 17, 68 cents; rice (106), 2, 8 cents; shredded wheat (109), 8, 32 cents; wheat (112), 3, 12 cents. Total breakfast cereals.....	7.2	12.5	405	10.6	309
Bread, white (113), 44, 44 cents; bread, corn (119), 48, 48 cents; rolls (131), 23, 23 cents; toast, buttered (135), 8, 24 cents; griddlecakes (147), 1, 5 cents. Total bread, crackers, etc.....	6.9	27.9	958	23.7	872
Cake (158), 18, 24 cents; cookies (161), 17, 17 cents; gingerbread, (168), 1, 1 cent; pies (172), 4, 20 cents; puddings (175), 6, a 28 cents; coffee jelly (185), 4, 16 cents. Total desserts, etc.....	5.0	8.6	496	7.3	461
Beans, baked (189), 7, 28 cents; potatoes, baked (199), 12, 24 cents; potatoes, fried (207), 2, 4 cents; potatoes, mashed (203), 11, 22 cents; sweet potatoes (216), 5, 10 cents; tomatoes, stewed (234), 3, 9 cents. Total vegetables.....	4.6	11.6	401	9.6	365
Bananas (245), 1, 2 cents; grapes (247), 2, 6 cents; preserves (257), 6, 24 cents. Total fruits.....	1.5	.2	58	.2	51
Sirup (260), 1, 2 cents; sugar, teaspoonfuls (259), 118, 0. <i>b</i> Total sugars, etc.....	.1	.....	210	.....	206
Coffee (263), 4, 12 cents.....	.6	.3	6	.3	6
Total food.....	38.4	92.6	3,144	82.3	2,879
<i>Period 2, 3 weeks, February 15 to March 6.</i>					
Beef, roast (7), 1, 10 cents; beef, corned (3), 2, 16 cents; beefsteak (11), 1, 10 cents; beef croquettes (19), 1, 10 cents; beef hash (21), 1, 7 cents; lamb, roast (33), 4, 40 cents; chicken wings (with toast), (52), 1, 10 cents. Total meats, etc.....	4.9	15.0	171	14.5	149
Soup (60), 7, 21 cents.....	1.0	1.3	18	1.3	16
Butter (88), 47, 47 cents; milk, glass (95), 2, 4 cents; milk, bowl (hot), (94), 1, 5 cents; milk, 4-ounce pitchers (96), 31, 31 cents. Total dairy products....	4.1	6.7	352	6.5	327
Oatmeal (104), 20, 60 cents; rice (107), 1, 3 cents; shredded wheat (109), 3, 12 cents; wheat (110), 6, 18 cents. Total breakfast cereals, etc.....	4.4	7.1	223	6.0	203
Bread, white (114), 16, 16 cents; bread, corn (120), 50, 50 cents; biscuit (126), 1, 1 cent; rolls (132), 53, 53 cents; toast (with chicken wings) (139), 1, 0; <i>b</i> toast, buttered (135), 8, 24 cents; toast, creamed (138), 1, 7 cents; griddlecakes (145), 2, 10 cents; crackers (153), 4, 4 cents. Total bread, crackers, etc.....	7.9	30.1	1,065	25.6	969
Cookies (162), 11, 11 cents; gingerbread (169), 7, 7 cents; coffee jelly (186), 13, 52 cents; cake (159), 25, 30 cents; pie (173), 4, 20 cents; pudding (176), 5, 20 cents; tarts (181), 1, 2 cents; fritters, apple (171), 1, 7 cents. Total desserts.....	7.1	10.8	601	9.2	559
Beans, baked (190), 1, 4 cents; peas (196), 1, 3 cents; potatoes, baked (200), 6, 12 cents; potatoes, mashed (204), 10, 20 cents; sweet potatoes (217), 2, 4 cents; tomatoes, stewed (232), 4, 12 cents; turnips, mashed (235), 1, 3 cents; pickles, sweet (237), 2, 10 cents. Total vegetables.....	3.2	4.8	190	4.0	173
Apples, baked (241), 1, 4 cents; bananas (243), 6, 12 cents; figs, dried (249), 4, 16 cents; oranges (250), 9, 27 cents; preserves, damson (257), 5, 20 cents. Total fruits.....	3.8	1.8	164	1.5	144
Sugar (259), 95, 0; <i>b</i> sirup (260), 2, 4 cents. Total sugars, etc.....	.2	.....	180	.....	176
Cocoa (262), 1, 3 cents.....	.1	.1	3	.1	3
Combination lunch (272), 1, 10 cents.....	.5	1.5	47	1.4	43
Total food.....	37.2	79.2	3,014	70.1	2,762

a Includes one order at 3 cents.

b See footnote r to Table 1.

TABLE 10.—*Kinds of food, number of orders, and cost of each kind, and average cost and amounts of protein and energy of dietary study No. 408—Continued.*

SUBJECT H—Continued.

Kinds of food, number of orders, and cost of each kind.	Cost, protein, and energy of daily food.				
	Total.			Digestible protein.	Available energy.
	Cost.	Protein.	Energy.		
<i>Period 3, 3 weeks, May 8 to May 28.</i>					
Beef, roast (8), 2, 20 cents; beef, corned (4), 2, 16 cents; beefsteak (12), 3, 30 cents; beef, frizzled with eggs (24), 1, 9 cents; lamb, roast (34), 2, 20 cents; chicken wings (with toast) (53), 1, 10 cents. Total meats, etc.	<i>Cents.</i> 5.0	<i>Grams.</i> 13.0	<i>Calories.</i> 149	<i>Grams.</i> 12.6	<i>Calories.</i> 130
Soups (61), 4, 12 cents	.6	1.2	17	1.2	15
Eggs, dropped (77), 6, ^a 18 cents	.8	1.9	24	1.8	21
Butter (89), 43, 43 cents; cream (with strawberries) (93), 1, 0; ^b milk, glass (95), 5, 10 cents; milk, 4-ounce pitchers (96), 20, 20 cents. Total dairy products	3.5	5.3	322	5.1	299
Oatmeal (105), 16, 48 cents; shredded wheat (109), 11, ^a 22 cents; wheat (111), 3, 9 cents. Total breakfast cereals	3.8	7.3	228	6.2	207
Bread, white (115), 22, 22 cents; bread, corn (121), 49, 49 cents; biscuit (127), 1, 1 cent; rolls (133), 45, 45 cents; toast, buttered (136), 2, 6 cents; toast (with chicken wings) (139), 1, 0. ^b Total bread, crackers, etc	5.9	26.3	903	22.4	822
Cake (160), 16, 16 cents; cookies (163), 9, 9 cents; doughnuts (166), 1, 1 cent; gingerbread (170), 3, 3 cents; pie (174), 14, ^c 57 cents; puddings (177), 4, 16 cents; coffee jelly (187), 7, 28 cents; ice cream (184), 2, 14 cents; sherbet (188), 1, 6 cents. Total desserts, etc	7.1	10.9	674	9.3	627
Beans, baked (191), 1, 4 cents; beans, Lima (194), 2, 4 cents; peas (197), 2, 4 cents; potatoes, baked (201), 8, 16 cents; potatoes, mashed (205), 9, 18 cents; potatoes, stewed (206), 1, 2 cents; succotash (231), 4, 8 cents; tomatoes, stewed (233), 5, 10 cents; turnips (235), 1, 2 cents; potato salad (215), 1, 5 cents; corn (225), 1, 2 cents. Total vegetables	3.6	5.9	197	4.9	179
Bananas (244), 3, 6 cents; oranges (251), 2, 6 cents; strawberries (with cream) (256), 1, 7 cents; preserves (257), 8, 32 cents; sauces (258), 3, 12 cents. Total fruits	3.0	.6	97	.5	85
Sugar (259), 130, 0 ^b			220		246
Coffee (263), 3, 9 cents; lemonade (267), 21, 42 cents; tea (263), 3, 9 cents. Total beverages	2.8	.4	99	.4	97
Combination lunches (273), 3, 30 cents	1.4	2.4	97	2.2	89
Total food	37.5	75.2	3,027	66.6	2,787
Average of the three periods	37.7	82.3	3,062	73.0	2,809

^a Orders for one-half the usual amount.^b See footnote *r* to Table 1.^c Includes one order at 5 cents.

The results of the dietary study show that the food contained on an average for the three periods 73 grams of digestible protein and 2,809 calories of available energy, and cost about 37.7 cents per day. Although the cost remained fairly constant, the value of the day's ration fell off uniformly toward a minimum in period 3. The diet was quite largely vegetarian in character, animal foods furnishing only 34.5 per cent of the total protein and 18.5 per cent of the total energy noted above. Only about 10 per cent of the average number of combination meals was eaten. Meats furnished about the usual proportion of total nutrients, but dairy products furnished only about 80 per cent of their usual proportion.

On the other hand, the vegetable foods, as might be inferred, were consumed in greater quantities than usual. Thus the expenditure for breads was about 25 per cent, for cereals about 65 per cent, for desserts about 150 per cent, and for vegetables about 40 per cent above the average. There was a noticeable decline in the amount of protein in the diet during the second and third periods, while the price of the diet per day remained nearly the same; thus in the three periods, the ratio of digestible protein to available energy was 1 gram to 35 calories, 1 gram to 40 calories, and 1 gram to 42 calories, respectively. Perhaps the chief reasons for this were decrease in the amount of protein obtained per money unit expended for meats in period 3, the use of more butter and cream and less milk in both periods 2 and 3, and a general tendency toward a more liberal purchase of the less economical foods.

At the end of the investigation Subject H had gained 4.8 pounds and showed the usual slight increase in anthropometric measurements and in strength-test figures. Medical examination showed no change in his general physical condition. In the examinations at the end of the college year he attained an average grade of about B.

We have, then, in the case of Subject H a student rather older than the average of those studied, who performed a creditable year's work at college on a diet somewhat vegetarian in nature, which averaged for the three test periods 73 grams of digestible protein and 2,809 calories of available energy, amounts which are respectively 79.5 and 104 per cent of those called for by the commonly accepted standard for a man of sedentary habits, without showing any evidence of physical deterioration. In fact, in this instance the gain of nearly 5 pounds is ground for believing that he was certainly in equilibrium with his environment, especially since he had passed the age of greatest bodily development.

DIETARY STUDY NO. 409.

Subject I was 16 years old, 5 feet 4.2 inches in height, and weighed 110 $\frac{1}{4}$ pounds. He was classed as well developed and well nourished, though compared with the average college student of the same age his measurements were a little below the normal. He was a freshman in the college and took the usual broad foundation studies, carrying, however, six instead of the customary five courses, which gave him a rather full year's work. He slept from 8 $\frac{1}{4}$ to 8 $\frac{1}{2}$ hours and spent from 7 $\frac{1}{2}$ to 8 $\frac{3}{4}$ hours daily in college work. In addition to this he did clerical work amounting to a total of 36 to 45 hours in the first, 9 to 24 hours in the second, and 4 to 10 hours in the third period. He took very little exercise. Thus, during the three weeks of period 1 he walked 4 hours, during period 2 he walked 1 to 2 hours, and during period 3 he took an hour's walk on one occasion and on another he rode a bicycle for 5 hours.

TABLE 11.—*Kinds of food, number of orders, and cost of each kind, and average cost and amounts of protein and energy of dietary study No. 409.*

SUBJECT I.

[For explanation of numbers in parentheses, see p. 11.]

Kinds of food, number of orders, and cost of each kind.	Cost, protein, and energy of daily food.				
	Total.			Digestible protein.	Available energy.
	Cost.	Protein.	Energy.		
<i>Period 1, 3 weeks, November 30 to December 20.</i>	<i>Cents.</i>	<i>Grams.</i>	<i>Calories.</i>	<i>Grams.</i>	<i>Calories.</i>
Soup (59), 5, 15 cents.....	0.7	1.0	16	1.0	14
Butter (87), 12, 12 cents; milk, bowl (94), 14, 56 cents; milk, 4-ounce pitchers (96), 42, 42 cents. Total dairy products.....	5.2	10.0	272	9.7	253
Hominy (100), 9, 36 cents; oatmeal (103), 11, 44 cents; rice (106), 2, 8 cents; wheat (112), 20, 80 cents. Total breakfast cereals, etc.....	8.0	10.3	362	8.8	329
Bread, white (113), 8, 8 cents; bread, Graham (116) 9, 9 cents; bread, corn (119), 16, 16 cents; biscuit (125), 5, 5, cents; rolls (131), 44, 44 cents; crackers for soup (152), 5, 5 cents. Total bread, crackers, etc.....	4.1	19.2	669	16.3	609
Cake (158), 2, 2 cents; cookies (161), 3, 3 cents; doughnuts (164), 3, 3 cents; gingerbread (168), 6, 6 cents. Total desserts, etc.....	.7	1.7	116	1.4	108
Potatoes, mashed (203), 5, 10 cents.....	.5	.9	38	.7	35
Sugar, teaspoonfuls (259), 203, 0 <i>a</i>			343		336
Cocoa (262), 7, 21 cents.....	1.0	.7	19	.7	19
Combination dinners (274), 3, 36 cents.....	1.7	4.6	110	4.2	101
Total food.....	21.9	48.4	1,945	42.8	1,804
<i>Period 2, 3 weeks, February 14 to March 6.</i>					
Beefsteak (11), 1, 10 cents.....	.5	1.7	16	1.7	14
Chowder (57), 1, 3 cents; soup (60), 2, 6 cents. Total soups, etc.....	.4	.7	12	.7	10
Butter (88), 17, 17 cents; milk, bowl (94), 18, 72 cents; milk, 4-ounce pitchers (96), 22, 22 cents. Total dairy products.....	5.3	14.2	383	13.8	263
Prepared cereal (98), 1, 4 cents; oatmeal (104), 19, 57 cents; rice (107), 1, 3 cents; wheat (110), 1, 3 cents. Total breakfast cereals.....	3.2	5.3	156	4.5	142
Bread, white (114), 15, 15 cents; bread, corn (120), 9, 9 cents; biscuit (126), 2, 2 cents; rolls (132), 89, 89 cents; gems, Graham (128), 2, 2 cents; crackers (153), 3, 3 cents. Total bread, crackers, etc.....	5.7	25.7	877	21.8	798
Cake (159), 7, 15 cents; doughnuts (165), 3, 3 cents; éclair (167), 2, 8 cents; pie (173), 8, 40 cents. Total desserts, etc.....	3.1	4.3	285	3.7	265
Beans, baked (190), 1, 4 cents; potatoes, baked (200), 1, 2 cents; potatoes, mashed (204), 1, 2 cents. Total vegetables.....	.4	1.3	32	1.1	29
Apples (240), 1, 2 cents; bananas (243), 4, 8 cents. Total fruits.....	.5	.2	22	.2	19
Sugar, teaspoonfuls (259), 204, 0 <i>a</i>			345		338
Cocoa (262), 21, 63 cents.....	3.0	2.0	57	1.9	56
Combination breakfast (269), 1, 10 cents; lunches (272), 18, \$1.80; dinners (275), 2, 24 cents. Total combination meals.....	10.2	31.5	956	29.0	879
Total food.....	32.3	86.9	3,141	78.4	2,813
<i>Period 3, 3 weeks, May 8 to May 28.</i>					
Beef hash (22), 1, 6 cents.....	.5	1.5	22	1.5	19
Butter (89), 23, 23 cents; milk, bowl (94), 19, 76 cents; milk, 4-ounce pitchers (96), 21, 21 cents. Total dairy products.....	5.7	14.6	427	14.2	397
Oatmeal (105), 20, 60 cents; rice (108), 1, 3 cents. Total breakfast cereals.....	3.0	6.7	189	5.7	172
Bread, white (115), 17, 17 cents; bread, corn (121), 1, 1 cent; biscuit (127), 8, 8 cents; rolls (133), 100, \$1; macaroni (156), 2, 12 cents. Total bread, crackers, etc.....	6.6	31.4	1,074	26.7	977
Cake (160), 11, 14 cents; pie (174), 10, 42 cents; shortcake, strawberries only (179), 1, 7 cents; shortcake, crust only (180), 1, 0; <i>a</i> sherbet (188), 2, 12 cents. Total desserts, etc.....	3.5	5.1	346	4.3	322
Beans, baked (191), 1, 4 cents; potatoes, hashed (214), 1, 2 cents; potatoes, fried (208), 1, 2 cents. Total vegetables.....	.4	1.2	48	1.0	44
Sugar, teaspoonfuls (259), 217, 0 <i>a</i>			367		360

*a*See footnote *r* to Table 1.
*b*Includes two orders of pie at 5 cents each.

TABLE 11.—*Kinds of food, number of orders, and cost of each kind, and average cost and amounts of protein and energy of dietary study No. 409—Continued.*

SUBJECT I—Continued.

Kinds of food, number of orders, and cost of each kind.	Cost, protein, and energy of daily food.				
	Total.			Digestible protein.	Available energy.
	Cost.	Protein.	Energy.		
<i>Period 3, 3 weeks, May 8 to May 28—Continued</i>					
Cocoa (262) 16, 48 cents. lemonade (267), 9, 18 cents; tea (263), 1, 3 cents. Total beverages	<i>Cents.</i> 3.3	<i>Grams.</i> 1.6	<i>Calories.</i> 84	<i>Grams.</i> 1.6	<i>Calories.</i> 82
Combination lunches (273), 15, \$1.50, dinners (276), 3, 36 cents. Total combination meals.....	8.9	15.7	574	11.4	528
Total food.....	31.9	77.8	3,131	69.4	2,901
Average of the three periods.....	28.7	71.0	2,739	63.5	2,506

The diet of this subject is noteworthy in several respects. During the three weeks of period 1 he lived on a ration which cost about 22 cents per day and supplied the remarkably small total of 42.8 grams of digestible protein and 1,804 calories of available energy. He ate no meat except that which was served with the combination meals, of which there were only three during the entire period. Except for butter and milk, which supplied about 25 per cent of the total protein and 14 per cent of the total energy, he was practically a vegetarian, depending on breads and cereals for about 59 per cent of the total protein and on bread, cereals, and sugar for 70.5 per cent of the total energy obtained. Two pages from his book will give an idea of the character of the diet which he selected, though, as will be observed from the table above, the total number of combination meals was very small.

Sample menus, Subject I.

DECEMBER 2.

Breakfast:	Cost, cents.
Cracked wheat and milk (with 3 to 4 teaspoonfuls sugar)	5
One hot bisquit (about 57 grams).....	1
Total	6
Lunch:	
Boiled rice and milk (with 3 to 4 teaspoonfuls sugar)	5
Corn bread (about 43 grams).....	1
Total	6
Dinner:	
Combination dinner, which consisted of a plate of soup, roast turkey and dressing, a small saucer of mashed tomatoes, a saucer of stewed corn (about two teaspoonfuls), a roll, a small pat of butter (11 grams), a cup of cocoa, and a dish of pudding (150 grams).....	16
Total cost for the day.....	28

DECEMBER 17.

	Cost, cents.
Breakfast:	
Cracked wheat and milk (with 3 to 4 teaspoonfuls sugar)	5
Two biscuits	2
Pat of butter	1
Total	8
Dinner:	
Boiled hominy and milk (with 3 to 4 teaspoonfuls sugar)	5
Four slices bread	2
Pat of butter	1
Total	8
Supper:	
Bowl of milk (about 12 fluid ounces)	4
Two rolls (48 grams each)	2
Total	6
Total cost for the day	22

Subject I apparently found that he did not get enough to eat in this manner for 22 cents a day, and accordingly we find him spending more at the time covered by the second and third periods. On an average his daily ration then cost about 32 cents and furnished 73.9 grams of digestible protein and 2,857 calories of available energy. During these periods animal foods furnished 43.5 per cent of the total protein and 26 per cent of the total energy noted, a ratio which was not materially different from that shown in the dietaries of several of the other subjects. The diet, as in many other cases, could have been improved as regards economy by spending less on desserts and beverages and more on some other foods. As the tables stand, the ration for periods 2 and 3 furnishes more than the average amounts of nutrients for 1 cent, as compared with the other studies, and this is due largely to the fact that the ration was simple as regards the classes of foods selected. It is further true that Subject I chose to eat only a few simple foods of each class rather than a considerable variety, and this explains the fact that in every important food class he obtained for 1 cent amounts of nutrients never below and often a little above the corresponding average amounts for the ten men.

At the end of the investigation he weighed 127 pounds, having made the surprising gain of 16.8 pounds during the experimental period, and his anthropometric measurements, as might be expected, also show a marked increase. No change, except an increase in adipose tissue, etc., was found in his physical condition and general health, but it seems certain that there was no deterioration. He passed the final

examinations in all his studies with an average grade of B. When we remember that he carried six courses and did outside clerical work in addition to his college work, this is a very creditable showing.

It appears, then, that this subject, 16 years old at the beginning of the investigation, performed his college work with credit and gained steadily in bodily weight throughout the year without the slightest sign of deterioration in his general physical condition on a diet which furnished on an average 63.5 grams of digestible protein and 2,506 calories of available energy per diem.

DIETARY STUDY NO. 410.

Subject K was 22 years old, 5 feet 6.8 inches in height, and weighed 151 pounds. He alone of all the men studied seemed thoroughly strong and robust physically, and such a man as one would consider fit to take an active part in college athletics. His anthropometric measurements showed him to be generally above the normal for men of his age and he was classed on examination as well developed and well nourished.

He was a senior in the college and devoted himself to the study of Greek and classical philology, carrying four and one-half advanced courses. On an average he spent daily 10 to 11¼ hours on college work, including lectures, reading, etc., and slept 6¾ to 7 hours. His only physical exercise for the entire three periods was a walk of an hour, but during the first period he served as a waiter at Randall Hall 1½ to 3 hours daily for 16 days, during the second period 1 to 4 hours daily for 17 days, and during the third period 2¼ to 4½ hours daily for the entire three weeks. From this it appears that his working day covered 12 to 14 hours.

TABLE 12.—*Kinds of food, number of orders, cost of each kind, and average cost and amounts of protein and energy of dietary study 410.*

SUBJECT K.

[For explanation of numbers in parentheses, see p. 11.]

Kinds of food, number of orders, and cost of each kind.	Cost, protein, and energy of daily food.				
	Total.			Digestible protein.	Available energy.
	Cost.	Protein.	Energy.		
<i>Period 1, 3 weeks, November 30 to December 20.</i>	<i>Cents.</i>	<i>Grams.</i>	<i>Calories.</i>	<i>Grams.</i>	<i>Calories.</i>
Beefsteak (10), 1, 10 cents	0.5	1.4	14	1.4	12
Chowder (57), 2, 6 cents; purée of peas (58), 1, 3 cents; soup (59), 2, 6 cents. Total soups, etc.....	.7	1.5	29	1.5	25
Milk, bowl (94), 3, 12 cents; milk, glass (95), 1, 2 cents; milk, 4 ounce pitchers (96), 2, 2 cents. Total dairy products.....	.7	2.4	52	2.3	48
Prepared cereal (97), 1, 4 cents; hominy (100), 8, 32 cents; oatmeal (103), 2, 8 cents; wheat (112), 1, 4 cents. Total breakfast cereals, etc.	2.3	2.7	107	2.3	100
Bread, white (113), 13, 13 cents; bread, Graham (116), 11, 41 cents; bread, corn (119), 4, 4 cents; rolls (131), 1, 1 cent; crackers (152), 2, 2 cents. Total breads, crackers, etc.....	2.9	16.8	546	11.3	497

TABLE 12.—*Kinds of food, number of orders, cost of each kind, and average cost and amounts of protein and energy of dietary study 410—Continued.*

SUBJECT K—Continued.

Kinds of food, number of orders, and cost of each kind.	Cost, protein, and energy of daily food.				
	Total.			Digestible protein.	Available energy.
	Cost.	Protein.	Energy.		
<i>Period 1, 3 weeks, November 30 to December 20—Cont'd.</i>					
Doughnuts (164), 1, 1 cent; gingerbread (168), 1, 1 cent; pie (172), 1, 5 cents; ice cream (182), 1, 7 cents. Total desserts, etc.....	<i>Cents.</i> 0.7	<i>Grams.</i> 0.7	<i>Calories.</i> 50	<i>Grams.</i> 0.6	<i>Calories.</i> 47
Beans, baked (189), 2, 8 cents; potatoes, baked (199), 26, 52 cents; sweet potatoes (216), 31, 62 cents. Total vegetables.....	5.8	14.3	790	11.9	719
Sugar, teaspoonfuls (259), 19, 0 ^a.....	.....	.....	32	.....	31
Combination dinner (274), 1, 12 cents.....	.6	1.5	37	1.4	34
Total food.....	14.2	41.3	1,657	35.7	1,513
<i>Period 2, 3 weeks, February 14 to March 6.</i>					
Beefsteak (11), 11, \$1.10.....	5.2	18.6	179	18.0	156
Purée of peas (58), 3, 9 cents; soup (60), 1, 3 cents. Total soups, etc.....	.6	1.3	28	1.3	24
Eggs, boiled (77), 7, 28 cents; eggs, fried (79), 4, 32 cents. Total eggs.....	2.9	4.3	68	4.2	61
Butter (88), 7, 7 cents; milk, glass (95), 10, 20 cents; milk, bowl (94), 1, 4 cents. Total dairy products.....	1.5	3.8	112	3.7	104
Prepared cereals (98), 2, 8 cents; hominy (101), 6, 18 cents; oatmeal (104), 9, 27 cents; rice (107), 3, 9 cents; wheat (110), 9, 27 cents. Total breakfast cereals, etc.....	4.2	6.3	225	5.4	205
Bread, white (114), 13, 13 cents; bread, Graham (117), 71, 71 cents; bread, corn (120), 36, 36 cents. Total bread, crackers, etc.....	5.7	31.5	1,037	26.8	944
Cake, fruit (159), 28, 28 cents; cookies (162), 2, 2 cents; gingerbread (169), 3, 3 cents. Total desserts, etc.....	1.6	4.3	267	3.7	248
Beans, baked (190), 1, 4 cents; potatoes, baked (200), 24, 48 cents; sweet potatoes (217), 13, 26 cents. Total vegetables.....	3.7	8.7	434	7.2	395
Bananas (243), 3, 6 cents.....	.3	.2	14	.2	12
Sugar, teaspoonfuls (259), 61, 0 ^a.....	.....	.....	103	.....	101
Coffee (263), 1, 3 cents.....	.1	.1	2	.1	2
Total food.....	25.8	79.1	2,469	70.6	2,252
<i>Period 3, 3 weeks, May 8 to May 28.</i>					
Beefsteak (12), 3, 30 cents.....	1.4	4.8	46	4.7	40
Soups (61), 2, 6 cents.....	.3	.6	9	.6	8
Eggs, fried (80), 5, 30 cents.....	1.4	2.6	50	2.5	45
Butter (89), 20, 20 cents; milk, bowl (94), 1, 4 cents. Total dairy products.....	1.2	.7	111	.7	103
Prepared cereal (99), 7, 28 cents; hominy (102), 7, 21 cents; oatmeal (105), 10, 30 cents, wheat (111), 6, 18 cents. Total breakfast cereals.....	4.6	8.4	287	7.1	261
Bread, white (115), 18, 18 cents; bread, Graham (118), 73, 73 cents. Total bread.....	4.3	25.8	826	21.9	752
Cake (160), 2, 2 cents; cookies (163), 1, 1 cent; pie (174), 8, 32 cents. Total desserts, etc.....	1.7	2.7	194	2.3	180
Potatoes, baked (201), 28, 56 cents; potatoes, boiled (202), 13, 26 cents. Total vegetables.....	3.9	6.7	270	5.6	246
Bananas (244), 16, 32 cents.....	1.5	.9	69	.8	61
Sugar, teaspoonfuls (259), 49, 0 ^a.....	.....	.....	83	.....	81
Total food.....	20.3	53.2	1,945	46.2	1,777
Average for the three periods.....	20.3	57.9	2,024	50.8	1,847

^a See footnote r to Table 1. ^b Orders for half the usual amount.

The above dietary is especially noteworthy because of the unusually small amount of nutrients and energy eaten daily, and also because of the low cost. On an average for the three periods the ration cost but 20.1 cents per day, and furnished 50.8 grams of digestible protein and 1,847 calories of available energy, only 55 and 68.5 per cent, respec-

tively, of the amounts called for by the commonly accepted standard for men of sedentary occupation.

Animal foods furnished about 24 per cent of the total protein and 11 per cent of the total energy, the lowest ratio of animal to vegetable nutrients noted in the entire investigation. Practically no combination meals were used; meats furnished only about 75 per cent, and dairy products only about 33 per cent, of the quantity of protein and energy derived from foods of this kind in the average for all ten subjects. From this it is evident that the consumption of the common animal foods was very small. On the other hand, the vegetable and cereal foods were very liberally used; for example, vegetables furnished 16 per cent of the total protein and 25 per cent of the total energy, or about three and one-half times the average percentage for all the subjects; breads nearly 50 per cent, and cereals 80 per cent more than the average percentage amount noted in these studies. From the point of view of economy of purchase no criticism need be made of this dietary, as the choice of dishes was such that little more could have been bought for the same money. However, from a consideration of the records in the subject's daybook, selected at random, the diet would appear to be far from what is ordinarily considered normal, palatable, or satisfactory.

Sample menus, Subject K.

DECEMBER 15.

	Cost, cents.
Breakfast:	
Baked beans	4
Graham crusts (about equal to 2 slices of bread)	1
Baked potatoes	2
Total	7
Lunch:	
Cracked wheat and small pitcher of milk (4 ounces)	5
Supper:	
Two Graham crusts (about equal to 4 slices of bread)	2
Cup of hot water	0
Total	7
Total cost for the day	14

FEBRUARY 14.

Breakfast:	
Steak	10
Graham bread (2 slices)	2
Oatmeal (with sugar, but no milk)	3
Hot water	0
Total	15

	Cost, cents.
Lunch:	
Cracked wheat (with sugar, but no milk)	3
Baked potatoes (2 potatoes)	2
Graham crusts (see above)	1
Total	<u>6</u>
Supper:	
Two Graham crusts (see above)	2
Pat of butter (about 12 grams)	1
Fruit cake (1 small square)	1
Cup of hot water	0
Total	<u>4</u>
Total cost for the day	<u><u>25</u></u>

MAY 24.

Breakfast:	
Oatmeal (sugar, but no milk)	3
Baked potatoes (2 potatoes)	2
Graham crusts	1
Cup of hot water	0
Total	<u>6</u>
Lunch:	
Boiled hominy (sugar, but no milk)	3
Two Graham crusts	2
Baked potatoes (same as above)	2
Cup of hot water	0
Total	<u>7</u>
Supper:	
Boiled potatoes (2 potatoes)	2
Bread (4 slices of white bread)	2
Saucer of prepared cereal	3
Cup of hot water	0
Total	<u>7</u>
Total cost for the day	<u><u>20</u></u>

At the end of the investigation Subject K had gained 8.4 pounds and showed a corresponding increase in anthropometric measurements. Judged by the results of an examination, there was no change in his general health or physical condition. He passed his final examinations with a clean record of A's, which indicates a scholarship far above that of the average student.

It appears, then, that this subject, the best developed and most robust looking of all the men studied, judging by the data recorded, lived on the lowest diet (50.8 grams of digestible protein and 1,847 calories of available energy per day on an average) and performed a highly creditable year's work without signs of physical deterioration.

The amounts of protein and energy supplied by the diet of this subject are very small. The low protein would be understandable if the

supply of energy was correspondingly large. The value for energy is, however, so low that it seems not unlikely that owing to an oversight or misunderstanding some articles were omitted in recording the daily diet.

In experiments with the respiration calorimeter made by Atwater and his associates, it has been found that subjects who were performing almost no external muscular work expended as much energy per day as Subject K received from his diet on an average, and when their muscular activity was increased their output of energy was correspondingly larger. In other words, they required as much energy for the simple processes of living as was supplied by the recorded diet of this subject, who had considerable muscular exercise in connection with his usual daily occupations. It is difficult to believe, in the light of the law of the conservation of energy, that he could have subsisted on such a diet without some drain on his body, and certainly it can not be supposed that he could continue to draw upon his body throughout the college year without some effect upon it.

DISCUSSION OF RESULTS.

METHOD OF COMPUTING THE DIETARIES.

The practical impossibility of weighing and sampling all the cooked food on its way to the subjects, under conditions existing at Randall Hall, led to a method of making dietary studies different from that generally followed. As stated earlier (p. 5), records were kept of the number and kind of the portions of food served to each subject. The amount of food in each portion was estimated by weighing sample portions and finding an average value from these weighings, which was used to calculate the weight of the portions actually served to the men. This may be called the method of average weights, inasmuch as it rests upon the assumption that the weights of successive portions of any given cooked food, on account of accidental variations, swing around an ideal value, which can be determined by weighing a sufficient number of the portions and averaging the figures so obtained. That this is the case within certain limits of error was shown by the agreement between weighings of consecutive portions of any given article of food. This is nothing more than is to be expected where the same sized dishes and serving spoons are used day after day for serving the same foods. For example, to obtain the average weight of an order of white bread, nine portions were weighed as they came from the serving room on different days, with the following results: 66, 56, 63, 69, 64, 70, 62, 63, and 66 grams, the average being 64.3 grams. While the difference between the extremes is appreciable, the average variation from this average is only 3 grams, or 4.7 per cent.

The average variation of the successive weights from the average of all the weights, when reduced to a percentage basis, as in the above sample, may be called "percentage variation." The figure expressing the percentage variation is useful to indicate the degree of uniformity in the successive weights of the same article of food and furnishes an approximate measure of the accuracy of the method of averages which lies at the bottom of the whole investigation. The precise meaning of the percentage variation figure is clear from the following considerations: Let us suppose that the average weight of all the orders of bread eaten by a certain student during three weeks, determined by the actual weighing of each order, is found to be 100 grams. Suppose, also, that the average variation of the single orders from 100 grams is 4.7 grams; then the percentage variation is 4.7. This working average, as it may be termed, determined by a comparatively small number of observations, may or may not be 100 grams, the true average. For example, it may happen that the weights of the orders that we select for weighing are all above the true average or all below, instead of some above and some below. In the first instance the working average would be 104.7 grams, on the assumption that the specimen orders were dished out with the same uniformity that obtained when the true average was determined. In other words, the maximum error that the method is likely to introduce is 4.7 per cent of the total weight of the bread consumed.

Consider now the uniformity shown by other articles of food. For the important class of breadstuffs the percentage variation was found to be 7.6, for cereals it was 6.6, and for dairy products 6.6. Meats showed the greatest irregularities, the percentage variation being 13.5. Averaging the percentage variations of all the important articles gives 8.6—that is to say, if the same number of orders of all the various dishes were consumed, and we estimate the total weights by multiplying the average weight of each order by the number of orders eaten; the greatest error that lack of uniformity in the individual weights could reasonably be expected to introduce would be about 9 per cent of the total weight sought.

It does not follow, however, that the largest error to be expected in the final figures for protein and energy is 9 per cent, for all the articles of food are not of equal importance in the result. Evidently, if a subject eats but one or two orders of meat during a period, the addition to his average daily ration is small, and the error is slight if the item is left out altogether, hence it suffices to determine the nutrients and weight of the meat approximately. Similarly, in a ration consisting of meat and fruit in equal weights, it is unnecessary to determine either the weight of the fruit or its proportion of nutrients with the same accuracy as in the case of meat, since the low value of the fruit in terms of protein and energy makes its effect on the total value

of the ration slight. It is clear, then, that the exactitude with which we should know the weights of the various servings or portions of the different foods depends both upon the chemical composition of the food and upon the number of orders eaten. Since we know the amounts of protein and energy furnished by the various classes of food, viz., soups, dairy products, cereals, breads, vegetables, meats, etc., and the percentage variation applying to each class, it is quite possible to compute, approximately at least, the effect produced by these variations in the final figures expressing the energy and protein in the average ration. The following table shows the amounts of nutrients furnished by the different classes of food during the whole study, the percentage variations, and the effects on the totals:

TABLE 13.—*Proportion of protein and energy in average daily ration per man (for the entire investigation) furnished by various classes of food and probable maximum error introduced by variation in the size of consecutive orders of the various dishes.*

Classes of food.	Average variation in weights of individual portions.	Digestible protein furnished.	Probable maximum error in protein.	Available energy furnished.	Probable maximum error in energy.
	<i>Per cent.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Calories.</i>	<i>Calories.</i>
Soup.....	7.4	1.3	0.10	21.2	1.6
Hash, fish, meats.....	13.5	13.1	1.77	151.4	20.4
Dairy products.....	6.6	9.9	.65	370.8	24.5
Breakfast cereals.....	6.6	4.4	.29	151.2	10.0
Breads and crackers.....	7.6	21.6	1.64	780.2	59.2
Desserts.....	7.4	3.2	.24	212.9	15.7
Vegetables.....	9.2	4.2	.39	193.9	17.8
Fruits.....	11.8	.7	.08	59.5	7.0
Beverages.....	7.0	1.4	.10	44.2	3.1
Combination meals.....	8.0	15.2	1.22	459.0	36.7
Sugars.....	5.0	.....	.....	222.1	11.1
Eggs.....	7.2	3.1	.22	53.7	3.9
Total.....	.....	78.1	6.70	2,720.1	211.0

Multiplying the total probable maximum error in protein, 6.70 grams, by 100, and dividing by the total digestible protein furnished, 78.1 grams, gives 8.6 per cent as the average variation for digestible protein; a similar computation gives 7.8 per cent as the average variation for available energy; and the average of both is 8.2 per cent. This figure is believed to be the largest error that abnormal variations in the size of orders is likely to introduce into the dietaries. In the opinion of the writer, the actual error lies considerably below this, being perhaps 3 or 4 per cent. A carefully conducted dietary study where the method of weighing, sampling, and analyzing all food on hand at the beginning, received during, and remaining at the end of the period of examination is employed would probably yield results within about 1 per cent of the actual amount of nitrogen and energy in the food. The error inherent in the analytical determination of nitrogen and heat of combustion is so small that it may be neglected; but when one computes "protein" from the total nitrogen by using factors, another and sometimes considerable error may be introduced.

because of uncertainty regarding the nitrogen factor for protein.^a The use of "coefficients of digestibility" moreover is attended with uncertainty for, while they yield reasonably accurate results in the average of a considerable number of studies, the actual error in some individual results has been found to be as high as 5 per cent in one or more nutrients.^b The method of average weights which it was necessary to employ appears, therefore, to give results that are somewhat less accurate than the usual methods, but it is believed that the results are nevertheless sufficiently exact to be trustworthy and of practical value.

Another source of error in dietary work lies in the failure to obtain representative samples for analysis. In this investigation the unusually large variety of foods eaten by the various men made it practically impossible to sample and analyze every article; on the other hand, it should be pointed out that many of the materials were consumed to such a limited extent that, as far as the effect on the results is concerned, they might be estimated with ample accuracy from available data, or, indeed, neglected altogether without materially changing the final results. With a knowledge of the number of orders of each food eaten during the periods of study, it was possible to judge whether any given article was of sufficient importance to demand analysis. Table 1, page 6, gives the percentage of protein and energy per gram of the foods used during the dietary studies, including those analyzed in connection with these studies and those for which such figures were estimated from previous analyses. There is no way of learning precisely how nearly the figures obtained by our method of sampling, analysis, and estimation represent the true values of protein and energy for the amount of food involved. The writer is of the opinion that, although the sampling, etc., in this case may not have been as accurate as in the ordinary dietary study, nevertheless the error is no greater than that involved in the use of the average weights before discussed.

From the above consideration it seems reasonable to conclude that the dietaries express the daily rations of the subjects to within 3 to 4 per cent of both the protein and the energy involved.

RANDALL HALL DIETARIES COMPARED WITH THOSE OF OTHER STUDENTS.

In the discussion of the results of the individual dietaries, they have been compared with each other and with the commonly accepted standard for a man of sedentary occupation, a basis of comparison selected because it was believed that none of the subjects were occupied in such

^a See Atwater and Bryant, Connecticut Storrs Station Rpt. 1899, p. 76.

^b Ibid., p. 86.

a way that they performed any considerable amount of muscular work other than that necessitated by walking to and from recitations, meals, etc.

It is interesting to compare the results obtained with these students with those of studies made at other American colleges and universities and with the results of studies in professional men's families and other families. Such a comparison is made in the following table:

TABLE 14.—*Summary of results of dietary studies with students and dietary standards.*

[Quantities per man per day.]

	Cost per day.	In total food.		Digest- ible protein.	Avail- able energy.
		Protein.	Energy		
	<i>Cents.</i>	<i>Grams.</i>	<i>Calories.</i>	<i>Grams.</i>	<i>Calories.</i>
Students at Randall Hall:					
Subject A	32.3	85	3,108	76	2,859
Subject B	36.1	92	3,033	84	2,795
Subject C	41.7	97	3,196	88	2,947
Subject D	42.7	67	2,789	61	2,566
Subject E	43.3	105	2,969	97	2,712
Subject F	34.3	86	3,061	77	2,824
Subject G	62.4	120	3,656	110	3,326
Subject H	37.7	82	3,062	73	2,809
Subject I	28.7	71	2,739	63	2,506
Subject K	20.1	58	2,024	51	1,847
Average of all	37.9	86	2,964	78	2,720
Average of all except Subject K	39.9	89	3,068	81	2,817
Students at college commons, Wesleyan University:					
Subject No. 1	32.1	139	.....	126	4,188
Subject No. 2	32.1	91	.....	82	2,924
Subject No. 3	32.1	104	.....	95	2,992
Average	32.1	111	.....	101	3,368
Student boarding himself, Wesleyan University	31.6	145	.....	133	3,692
Student at University of California	26.0	94	.....	87	2,581
College boarding clubs:					
Men—					
At Wesleyan University, average 2 studies		98	.....	90	3,387
At University of Tennessee, average 5 studies	17.0	93	.....	85	3,437
At University of Missouri, average 2 studies		96	.....	88	3,450
At Maine State College, average 5 studies	28.0	121	.....	112	4,128
At Western Reserve University	25.5	140	.....	128	3,633
Average 15 studies		110	.....	101	3,607
Men and women—					
At Storrs (Conn.) Agricultural School		104	.....	96	3,564
Women ^a —					
At Wesleyan University		84	.....	78	2,531
At North Dakota Agricultural College	13.0	64	.....	59	2,579
At Lake Erie College	18.0	68	.....	62	2,610
At Chicago University	25.0	108	.....	99	2,866
At Western Reserve University	25.0	103	.....	94	2,970
Average		85	.....	79	2,711
Average of 14 professional men's families	28.0	104	.....	96	3,221
Average of 14 mechanics' families	19.0	103	.....	95	3,355
Average of 10 farmers' families		97	.....	89	3,413
Men at rest in respiration calorimeter		109	.....	103	2,418
DIETARY STANDARDS (ATWATER).					
Man with moderately active muscular work		125	.....	115	3,400
Man with light to moderate muscular work		112	.....	103	3,050
Man with sedentary occupation		100	.....	92	2,700
Man with very little physical exercise		90	.....	83	2,450

^a Quantities per woman per day. The corresponding amounts per man per day would be one-fourth greater, on the assumption that a woman eats 0.8 as much as a man under like conditions.

These comparisons afford an interesting illustration of the value of a knowledge of the relation between the cost and the actual nutritive value of food. This may be especially emphasized by a comparison of the average of the results for the Harvard students with those for the student at Wesleyan boarding himself. The latter had a clear idea of the nutritive value of different food materials and made his purchases accordingly. The cost of his diet was only about five-sixths of the average for the Harvard students, yet he obtained about seven-tenths more protein and a third more energy than they.

Some part of the larger average cost of the diet of the Harvard students is, of course, due to the operating expenses of the boarding club, which the Wesleyan student did not have to meet. The latter bought mostly food ready to eat and prepared his own meals. But even assuming that the difference was wholly due to such causes, the Wesleyan student could have obtained a diet equivalent in nutritive value to that of the average for the Harvard students for about 25 cents per day.

A comparison with other results given in the table is also interesting. In the studies with the three students boarding at the Wesleyan commons the diet ranged from 82 to 126 grams of digestible protein, and from 2,924 to 4,188 calories of energy, the average being 101 grams and 3,368 calories, which was appreciably larger than the average consumption for the Harvard students. This was true also in the case of the average of the results of 15 studies made with college boarding clubs in different parts of the country.

The above summary of the results of the studies at Randall Hall very plainly shows the wide difference in cost and nutritive value of the diet selected by the different students. The largest sum per man per day was that for Student G—namely, 62.7 cents—and the diet also supplied the largest amount of protein and energy; the smallest cost was that for Student K, and likewise the quantity of protein and energy in the diet was smaller than in that of any of the other subjects. On the other hand, the latter student, for a little less than one-third the cost, obtained very nearly one-half as much protein and considerably more than half as much energy as the former.

Subject F spent 2 cents per day more than Subject A for a diet practically the same in nutritive value. Subject A spent 5 cents per day less than subject H for a diet furnishing more protein and energy than that of the latter. Subject E spent only 0.4 cent more than Subject D, yet he obtained more energy and very much more protein in his diet than the latter: in fact Subject D spent more than twice as much as Subject K, who spent the least of all for food, yet he obtained only a little over a sixth more protein and a third more energy. It is evident from such comparisons that some of the students could have obtained considerably more actual nourishment than they did for the

same expenditure, or they could have had a diet equally as nutritious as the one they had for a smaller cost.

FOOD SUPPLY IN RELATION TO BODY WEIGHT.

In considering the nutrients supplied by a given ration and the adequacy of the diet, as compared with the accepted standard, it is interesting to make comparisons on the basis of nutrients supplied per kilogram of body weight—that is, in relation to the size of the subjects, since it seems obvious that a very small man would not have the same food requirements as a large one. It has been estimated that on an average the American man weighs not far from 150 pounds (68 kilograms). The commonly accepted dietary standard for an average man at sedentary employment (92 grams digestible protein and 2,700 calories of available energy) would, therefore, provide 1.4 grams protein and 40 calories of energy per kilogram body weight. The table below shows the amounts of digestible protein and available energy furnished per kilogram body weight by the dietaries reported in this bulletin and compares these values with the standard selected:

TABLE 15.—Daily income of digestible protein and available energy per kilogram body weight.

	Average weight.	Amounts per day.		Amounts per kilogram body weight.	
		Protein.	Energy.	Protein.	Energy.
	Kilograms.	Grams.	Calories.	Grams.	Calories.
Subject A.....	50.2	76.2	2,859	1.5	57
Subject B.....	60.7	83.9	2,795	1.4	46
Subject C.....	65.2	87.7	2,947	1.3	45
Subject D.....	54.5	61.5	2,566	1.1	47
Subject E.....	62.6	97.1	2,712	1.6	43
Subject F.....	54.9	77.2	2,824	1.4	51
Subject G.....	66.4	110.4	3,336	1.7	50
Subject H.....	59.3	73.0	2,809	1.2	47
Subject I ^a	53.8	63.5	2,506	1.2	47
Subject K.....	70.4	50.8	1,847	.7	21
Average of all.....	59.8	78.1	2,720	1.3	45
Average of all except Subject K.....	58.6	81.2	2,817	1.4	48
Man with sedentary occupation.....	68.0	92.0	2,700	1.4	40

^aThis student's ration was much larger in the second and third periods than in the first. If the average of the last two periods be taken as nearer normal, the income would be, per kilogram, protein 1.4 grams, energy 53 calories.

It will be seen that considering the average results for all the students the food furnished 1.3 grams digestible protein and 45 calories of available energy per kilogram body weight, or 7 per cent less protein and 12 per cent more energy than is called for by the standard selected for comparison. If the results obtained with Subject K, which there is some reason for considering exceptional, are omitted, the average amounts would be 1.4 grams digestible protein and 48 calories available energy, or as much protein and 20 per cent more energy than the standard calls for.

Considering the individual studies it will be noted that, with the

exception of Subject K, the amount of energy was in all cases greater than the standard, while that of protein equaled or exceeded it in five cases. Judging the results of the studies in accordance with this method of comparison, the amounts of protein and energy obtained were on an average sufficient to maintain the subjects in equilibrium with their environment.

THE STRENGTH TESTS.

At the beginning and end of each period of examination the subjects reported for strength tests, as has been noted. The system was that devised by Dr. D. A. Sargent and now used in many colleges. The individual taking the test is measured with a tape line and calipers. He is then made to exert his strength upon a series of spring dynamometers, the compression of which measures the strength of the various muscles. The results obtained are tabulated and, by comparison with a set of average results for men of the same age, the individual development may be deduced.

In the case of the men examined in this investigation the changes observed were very small for the most part and are within the limit of probable error in the method. A few of the more significant measurements are given in the following table:

TABLE 16.—*Ages and physical measurements of subjects.*

	Age.	Height.	Chest.	Waist.	Thigh.	Weight.	Strength.
	<i>Years.</i>	<i>Cm.</i>	<i>Cm.</i>	<i>Cm.</i>	<i>Cm.</i>	<i>Kgm.</i>	<i>Kgm.</i>
Subject A:							
Beginning.....	31	157.0	84	69	46.5	48.5	427
End		157.0	89	72	50.5	51.9	539
Gain.....		.0	5	3	4.0	3.4	112
Subject B:							
Beginning.....	20	161.5	85	74	52.0	59.8	698
End		162.0	89	73	54.5	61.7	767
Gain.....		.5	4	— 1	2.5	1.9	69
Subject C:							
Beginning.....	23	167.5	85	76	55.5	65.7	526
End		168.5	88	76	56.0	64.8	809
Gain.....		1.0	3	0	.5	.9	283
Subject D:							
Beginning.....	22	168.5	82	67	49.5	54.2	560
End		168.5	84	69	49.0	54.7	699
Gain.....		.0	2	2	.5	.5	139
Subject E:							
Beginning.....	26	166.5	90	75	51.5	61.8	637
End		166.5	94	76	53.5	63.5	743
Gain.....		.0	4	1	2.0	1.7	106
Subject F:							
Beginning.....	25	162.0	86	68	49.5	54.5	682
End		163.5	88	71	50.0	55.3	900
Gain.....		1.5	2	3	.5	.8	218
Subject G:							
Beginning.....	22	174.0	88	72	53.0	65.0	618
End		174.5	90	74	55.5	67.8	824
Gain.....		.5	2	2	2.5	2.8	206

TABLE 16.—*Ages and physical measurements of subjects—Continued.*

	Age.	Height.	Chest.	Waist.	Thigh.	Weight.	Strength.
Subject H:	Years.	Cm.	Cm.	Cm.	Cm.	Kgm.	Kgm.
Beginning.....	27	179.0	84	70	47.5	68.2	607
End		181.0	88	70	49.5	60.4	735
Gain.....		2.0	4	0	2.0	2.2	128
Subject I:							
Beginning.....	16	163.0	84	67	45.5	50.0	740
End		164.0	88	74	49.5	57.6	890
Gain.....		1.0	4	7	4.0	7.6	150
Subject K:							
Beginning.....	22	170.0	98	77	54.5	68.5	682
End		170.0	98	82	58.1	72.3	793
Gain.....		.0	0	5	3.6	3.8	111
Average	23.4	167.0	87.0	71.5	50.5	58.6	618
Average gain.....		.6	2.7	2.2	2.1	2.4	152
Per cent of average gain.....		.4	3.1	3.1	4.2	4.1	24.6

The gain in weight, averaging about 4 per cent, is the most significant point brought out by the table. Every subject but one (Subject C) showed a slight, but tolerably uniform, gain in weight throughout the year. As was to be expected, all the other measurements also increased more or less. In the case of the older of the men, i. e., those who had attained their full physical development, the gain in weight indicated that their diet was a little more than sufficient to maintain them in equilibrium with their environment. With the younger men it is a question whether their gain was more or less than normal growth demands; or, in other words, whether their diet was sufficient to maintain them in equilibrium with their daily work and also to supply the needs of bodies still growing and developing. It is impossible to answer this question from the data of this study, but it is clear that in every case but one (Subject C) the amount of nutritive material obtained was at least not too small to allow of a slight increase in the body weight.

The element of skill in applying one's power to the dynamometers influences results to an unknown extent, and the same individual after several successive trials often increases his previous records by several hundred points. The increase of about 25 per cent in the strength, as shown by the figures, can hardly be regarded as a reliable indication of actual gain in muscular strength, since it seems too small to lie outside the improvement arising from a mere repetition of trials.

The strength records of the subjects are rather lower than the general average of such tests with students at Harvard. The physical measurements recorded also show that the men included in the investigation were below the average. For example, as regards height, these men, on the average, would stand about twenty-fourth if we took 100 students at random and arranged them in a row, beginning with the smallest and ending with the tallest. As regards weight, they, as an average, would stand at the thirty-fourth place, beginning

with the lightest; in girth of chest, they would take forty-eighth place; in girth of waist, forty-third place, and in girth of thigh, forty-sixth place. Taking all measurements into account, they would stand at about the fortieth place.

GENERAL PHYSICAL CONDITION OF THE SUBJECTS.

At the time of the strength tests the men were given a medical examination by Dr. E. A. Darling somewhat resembling in character that required of applicants for life insurance. It was thought that such examinations, made by a physician, would bring to light any changes that would occur in the general health of the men—changes which the strength tests of course fail to indicate.

The general condition of the men as a whole at the beginning of the study was regarded as rather below par. Only two (Subjects I and K) of the ten were classed as well developed and nourished, six (B, C, E, F, G, and H) were in fair condition, and two (A and D) were poorly developed and nourished. None was actually in poor health, though one man had recently recovered from typhoid fever. During the period of study several of the men had slight illnesses, such as indigestion, etc., but nothing which affected their general condition to any great extent. At the time of the last examination most of the men declared that they felt better than at the first. Physical examination, however, showed no noticeable change except a slight increase of fat in several instances. There seemed certainly no deterioration.

Data recorded by the subjects themselves in regard to daily habits and occupations are summarized in the following table:

TABLE 17.—*Approximate daily programme of the different subjects.*

Subject.	Sleep.			Exercise.		
	Period 1.	Period 2.	Period 3.	Period 1.	Period 2.	Period 3.
	Hours.	Hours.	Hours.			
A	7½	8½	7½	Gymnasium ½ hour, or walking ½ to 2 hours, daily.	Gymnasium ½ hour, or walking ½ to 2 hours, daily.	Gymnasium ½ hour, or walking ½ to 2 hours, or bicycle ½ to 1 hour, daily.
B	7½	7½	7½	Walking 1 hour (5 days), football (5 days).	Walking ½ to 1 hour, 9 days.	Baseball ½ to 2 hours, 10 days.
C	7	7	7	Walking 3 hours (Sundays only).	Walking 2 hours (Sundays only).	Bicycle 1 hour, 11 days.
D	6½	7½	7	Gymnasium ½ to 1 hour, 9 days.	None	None.
E	7½	7½	8	Walking 2½ to 3 miles, daily.	Walking 2½ to 3 miles, daily.	Walking 2½ to 3 miles, daily.
F	8½	8	8	Walking or gymnasium ½ to 1 hour, daily.	Walking or gymnasium ½ to 1 hour, daily.	Walking or handball ¾ to 1½ hours, 7 days.
G	6½	6½	6½	Walking 1 to 2 hours, 2 days; skating ¾ hour, 1 day.	None	None.
H	8	7½	7½	Walking or bicycle ½ to 1 hour, 7 days.	Walking or gymnasium 1 hour, 10 days.	Bicycle ½ to 2 hours, 6 days.
I	8½	8½	8½	Walking 4 hours, 1 day.	Walking ½ to 1 hour, 2 days.	Walking 1 hour, 1 day; bicycle 5 hours, 1 day.
K	7	6½	6½	None	Walking 1 hour, 1 day.	None.

TABLE 17. — *Approximate daily programme of the different subjects*—Continued.

Subject.	College work—lectures, reading, etc.			Outside work.		
	Period 1.	Period 2.	Period 3.	Period 1.	Period 2.	Period 3.
	<i>Hours.</i>	<i>Hours.</i>	<i>Hours.</i>			
A	10	8	9	None	None	None.
B	8½	7½	8	Barber's shop 8 hours, 3 days.	Barber's shop 8 hours, 1 day; waiting on table at Randall 1 to 2 hours, 9 days.	None.
C	10½	12½	11	Waiting on table at Randall Hall 1 to 3 hours, daily.	Waiting on table at Randall Hall 1 to 3 hours, daily.	Waiting on table at Randall Hall 1 to 3 hours, 17 days.
D	12½	11½	12½	None	None	None.
E	9½	7½	6½	None	None	None.
F	7	7½	7	None	None	None.
G	9	9½	9½	None	None	None.
H	8½	7	7½	Waiting on table at Randall Hall ½ to 1½ hours, 10 days.	Waiting on table at Randall Hall ½ to 1½ hours, 13 days.	Waiting on table at Randall Hall ½ to 1½ hours, 12 days.
I	7½	8	8½	Clerical work 3 to 5 hours, 9 days.	Clerical work 1½ to 4 hours, 6 days.	Clerical work 1 to 2½ hours, 4 days.
K	11½	10	10½	Waiting on table at Randall Hall 1½ to 3 hours, 16 days.	Waiting on table at Randall Hall 1 to 4 hours, 17 days.	Waiting on table at Randall Hall 2½ to 4½ hours, daily.

The data recorded show that all the men spent a fair amount and some an unusually large proportion of time on their college work. All spent very little time, on the average, in exercise beyond that necessary for walking to and from lectures and meals, and, as a rule, indulged only in the lighter forms, such as walking and gymnasium work, with occasionally bicycling, baseball, and handball. The average time spent in sleep was somewhat less than is usual among college men.

Briefly, then, according to Doctor Darling's report, it may be said that (1) no appreciable change was observed in the general condition of the men during the period of observation; (2) the men spent rather less time than the average in sleep and exercise, but rather more than the average in the college work; and (3) the dietary was apparently sufficient to maintain the nutritive standard to which they were accustomed.

MENTAL WORK OF THE SUBJECTS.

A year's work for a man in regular standing at Harvard University consists of seldom less than four or more than six whole (i. e., lasting throughout the year) courses of study. The highest grade of marks given is "A," which indicates exceptionally good work. The grade "B" indicates work above the average, "C" is given for average work, and the grade "D" indicates that the student has "passed," but without credit.

As shown in the preceding table, five of the men engaged in no systematic mental work aside from that involved in their regular college courses. In these instances the grades or marks received by the men in their courses of study are a tolerably accurate measure of their

mental work. In the case of the men who did outside work the grades attained by them in their college courses are, of course, only an approximate indication of the amount of mental work. The following table shows the number of courses taken and the average grades attained by each subject for the year:

TABLE 18.—*Scholarship of the subjects as shown by the number of courses of study taken and the average grades attained throughout the year.*

Subject.	Kind of work.	Number of courses.	Average grade.	Remarks.
A	Mathematics	4	A	No outside work. First year student in graduate school.
B	History and languages.	5	(a)	Worked in barber shop and was waiter at Randall Hall. Freshman in the college.
C	General scientific.	6	(a)	Served as a waiter at Randall Hall and did clerical work. Was a sophomore in the college.
D	Mathematics and physics.	4	B	No outside work. Sophomore in the college.
E	Electrical engineering.	7	B	No outside work. Senior in the Lawrence Scientific School.
F	Greek, Latin, and classical philology.	4	A	No outside work. Second year student in graduate school.
G	General classic ...	5	(a)	No outside work. Senior in college.
H	History, philosophy, economics, etc.	4	B	Served as waiter at Randall Hall. Senior in the college.
I	General classic ...	6	B	Did clerical work. Freshman in college.
K	Greek	4½	A	Served as waiter at Randall Hall. Senior in the college.

a Between B and C.

A glance at the table shows that on the whole the work of these men in their college courses was of a very high grade; in fact, far above the average. Moreover, the studies pursued were, with some exceptions, of an advanced nature.

CONCLUSIONS.

The general trend of the results of these studies is clear. The ten young men performing approximately the same duties under the same general conditions lived on diets that differed widely in respect to the amounts of protein and energy supplied. The differences were noticeable not only with the different individuals, but also, in some cases, with the same individual in different periods. So far as it is possible to judge, the men appeared to be in bodily equilibrium on their various diets during the different periods; at least they showed no change in general physical condition that could be detected by careful medical examination.

In discussing the results of the investigations, especially with reference to the adequacy of the diet for daily needs, it has been assumed that the occupation of the subjects may be considered sedentary. A number of the men took more or less exercise and had some work other than that connected with their college duties, yet it seems fair to conclude that the daily lives of all the men should be called sedentary

because none of them apparently had as much exercise as mechanics and others engaged in various forms of muscular work, who are included in the group covered by the term "light to moderate muscular work." For all the subjects together the average daily consumption of digestible protein was 78 grams and the available energy of the food 2,720 calories, whereas the standard with which comparison has been made—namely, that for a man with sedentary occupation—suggests 92 grams digestible protein and 2,700 calories of available energy. In other words, as shown by this comparison, the average amount of digestible protein of the daily diet was less than the standard selected calls for, while the amount of available energy was about the same.

It is interesting, however, to consider the amount of digestible protein and available energy supplied by the food in comparison with the weights of the subjects. Assuming that the average American man weighs not far from 150 pounds (68 kilograms), the commonly accepted dietary standard for the average man at sedentary employment would, therefore, provide 1.4 grams protein and 40 calories of energy per kilogram body weight. As shown by the average results of all the students, the food furnished 1.3 grams digestible protein and 45 calories of energy per kilogram body weight, or 7 per cent less protein and 12 per cent more energy than is called for by the standard selected for comparison. In the case of the individual studies with one exception the amount of energy provided was greater than the standard calls for, while with five of the subjects the amount of protein equaled or exceeded the standard and with four it was only a little below it. It will be seen that when the comparison is made on the basis of actual weight of the subjects the agreement with the dietary standard is closer than on the basis of amounts per person per day.

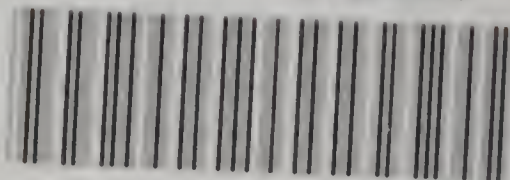
As has been stated, marked differences were observed in the amounts consumed by the different individuals and by the same individual in different periods, yet on the whole the subjects appeared to be in equilibrium with their environment. The question naturally arises then, what would be a suitable dietary standard for these men, since in some cases there appears to have been for a given subject not one ration only but several different rations which enabled him to do his customary work without apparent change in physical condition? It seems reasonably certain that as regards protein the daily requirement is not a fixed quantity either for different individuals under similar circumstances or for the same individual at all times. So far as any given individual is concerned, it is known that the quantity of protein may vary within rather wide limits and that the body seems capable of adapting itself under certain conditions to diets of markedly different character. When such facts are considered the variations in the amounts of protein in the diets of the different subjects or with the same subject in different periods are not surprising.

It is quite generally conceded that the dietary standards commonly accepted suggest amounts which experience has shown to be ample under usual circumstances for nourishing the body, maintaining it in harmony with its environment, and keeping up its resistance to any unfavorable conditions which may arise. It is recognized that in the case of individuals and groups variations from any such standard will always be found. The variations from the dietary standard observed in the case of these students are interesting, but are, of course, not uniform or numerous enough to warrant any modification of the standard. If average values per person are considered, it will be seen that the protein supplied was lower and the energy somewhat higher than the quantities called for by the standard, a variation which is in harmony with the commonly accepted theory that within limits a deficiency of protein may be compensated by an increase of energy. When the comparison is based on amounts per kilogram body weight the agreement with the dietary standards is fairly close in the case of protein, whereas the energy exceeds the standard.

As shown by the average results of studies made at a number of American colleges and universities, the diet of the group studied at Harvard furnished considerably less protein and energy than usual. The results reported in the present investigation are obviously too few for sweeping deductions, and probably no one would suggest that the diet of the average student is too large, because the students here studied lived on a diet furnishing smaller amounts of protein and energy. Nature is very accommodating, and there is apparently always an effort to bring the body into harmony with its environment in respect to food and other conditions. In the case of these students and others studied elsewhere there is no means of knowing the effect of the diet on their future health and well-being, or on their subsequent resistance to disease, or other conditions which would make unusual demands on their physical vigor. Such questions must be taken into account before final conclusions can be reached.

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